

Digitized by:



ASSOCIATION
FOR
PRESERVATION
TECHNOLOGY,
INTERNATIONAL

www.apti.org

BUILDING
TECHNOLOGY
HERITAGE
LIBRARY

<https://archive.org/details/buildingtechnologyheritagelibrary>

From the collection of:

Frank Heitzman, AIA

P. F. Norton
1981



THE
Builder's Dictionary :
OR,
Gentleman and Architect's
COMPANION.

Being
A Complete UNABRIDGED REPRINT

of the earlier work published by

A. BETTESWORTH and C. HITCH

of Benefit to

ARCHITECTS
LIBRARIANS
HISTORIANS
ANTIQUARIANS

ARTISTS
CRAFTSMEN

COLLECTORS
RESTORATIONISTS
PRESERVATIONISTS
STUDENTS, & c.

VOLUME ONE

WASHINGTON:

Published for the
ASSOCIATION FOR PRESERVATION TECHNOLOGY

MCMLXXXI

This first reprint
published in the United States of America
is limited to 1,500 copies

Introductory Material ©copyright 1981 by
The Association for Preservation Technology

All rights reserved

ISBN: 0-920476-06-6

Library of Congress Catalog Number: 81-67358

The Association for Preservation Technology
Box 2487, Station D
Ottawa, Ontario
K1P 5W6 Canada

ACKNOWLEDGMENTS

The Publications Committee of the Foundation for Preservation Technology offers special thanks to a number of people for their support and assistance without which this republication could not have come to fruition.

Ellen McAllister, Librarian, Mount Vernon, gave initial support and encouragement to Bennie Brown, Jr. and Nicolas F. Veloz, Jr., who first conceived the idea for the reprinting of this important publication. Nicolas F. Veloz, Sr. offered sustaining help at the inception of the project and continued support until his recent death.

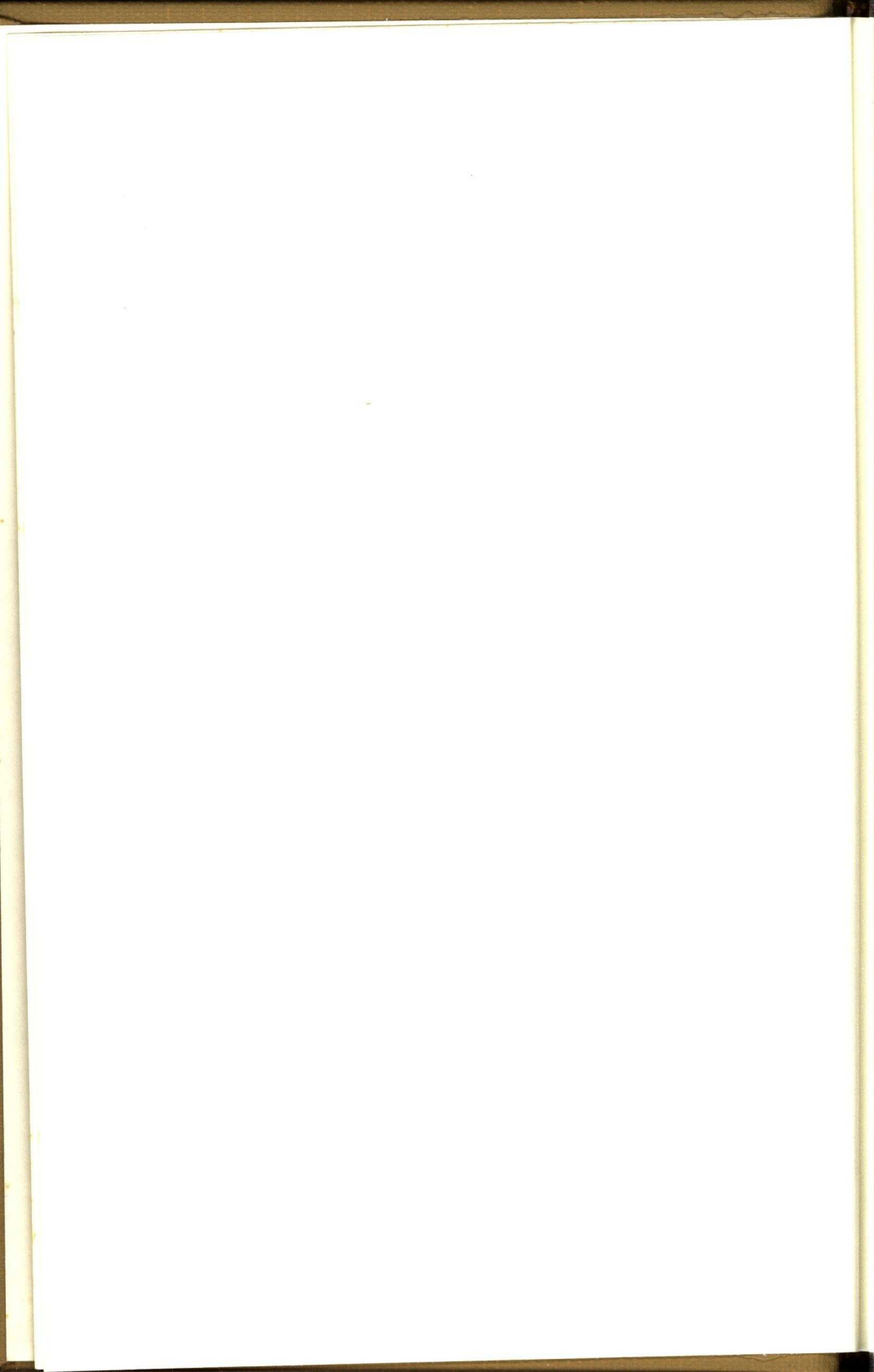
Mary and Jim Wiggins, Kwik-Kopy printers, gave support, advice and quality work for the promotional material in spite of very demanding deadlines. Dorothea McGay and Emily Duffy, Northlight Graphics, provided typesetting and graphic design services for the promotional and prefatory materials.

Bennie Brown, Jr., Curator of Collections, Gunston Hall, shared his preliminary research for a forthcoming publication on the sources and influences of early English architectural dictionaries.

Paul James, bookbinder, afforded special advice and assistance in making the original volumes ready for the printer by providing much needed resewing and rebinding of the originals.

Additional gratitude is expressed to numerous organizations and to the editors of those magazines, journals and newsletters who supported and publicized this project.

The work of the officers of the Foundation, the spouses, the secretaries, and employers who all had a very special role in the completion of this project is gratefully acknowledged.



P R E F A C E

When it was first published in 1734, *THE BUILDER'S DICTIONARY* was proclaimed to be the definitive English architectural encyclopedia. It was important enough to receive the approbation of the leading architects of the day, Nicholas Hawksmoor, John James, and James Gibbs. However, the historical importance of this work and its position in the evolution of the builders' manuals and lexicographic treatises of the period remains to be fully examined.

The end of the 17th century and the beginning of the 18th century saw a variety of publications that significantly influenced English architectural design and building practices. The harbinger of the builder's lexicon may have been Joseph Moxon's *MECHANICK EXERCISES*, published serially starting in 1670, written to demystify various crafts, including the building trades, which had been cloaked in guild secrecy. The inclusion of a glossary of terms, as in the 1703 edition of Moxon, may have been the beginning of an architectural dictionary.

The first major encyclopedic approach to the genre published in England was Neve's builder's dictionary of 1703, which was intended to inform the workman in the manner of Moxon. However, the format of the dictionary soon evolved into a medium more responsive to the layman's emerging interest in the building arts. The Second Edition of Neve's dictionary was introduced with a statement that "... by proper Additions It were made fit for Gentlemen's Use, as the former Edition was for Workmen . . ."

The presently reprinted *BUILDER'S DICTIONARY* published by Bettesworth in 1734 (and anonymously authored), fully recognized this lay interest. While it borrows heavily from Neve with some verbatim definitions, the two-volume work more than doubles the number of entries of previously published lexicons. This potpourri of terminology and descriptions of techniques and trade practices was intended for use by building owners, estate managers, and gentlemen architects.

THE BUILDER'S DICTIONARY was well known in colonial America. For example, John Carter of Shirley Plantation in Virginia cited painters' wages from *THE BUILDER'S DICTIONARY* in a 1738 letter relating to his own estate management responsibilities.

Bookseller Benjamin Franklin advertised THE BUILDER'S DICTIONARY for sale in Philadelphia a few years later. The title was listed in the catalogues of the Library Company of Philadelphia, the Redwood Library in Newport, and the Charleston Library Society, all in the mid-18th century. Thomas Jefferson had THE BUILDER'S DICTIONARY in his great library of over 6,000 volumes.

While it is clear that THE BUILDER'S DICTIONARY was compiled to meet the interests of building owners, managers and intellectuals in the building arts, it is uncertain how much influence this book had, if any, on craftsmen in the American colonies. It can be argued that building trade practices evolved empirically rather than from books or encyclopedic collections of data. THE BUILDER'S DICTIONARY probably did influence building by increasing general knowledge of practices and by establishing standards for performance, by builders and suppliers, for the benefit of clients and owners.

Our interest in this book lies in the recognition that it was a comprehensive compendium of ancient and contemporary knowledge when it was published in 1734. Much is revealed about early 18th-century nomenclature, craft practices, applicable laws governing building practices, and the evolution of the building trades. The intense interest in mathematics reflects the preoccupation with quantification of the building arts. However, the formulas and computations for building component design, the sizes and prices for materials, and the descriptions of manufacturing and craft practices were not written for architects or tradesmen since they knew all about them. This was a reference, not a how-to manual. This book was written to instruct the owner and user of buildings as to what the architect, the craftsman and the material supplier were doing or should be doing. Today we can use this book as a window into the theory and practices of the builder's world of the 18th century.

The Foundation for Preservation Technology

PRODUCTION NOTES

This edition of THE BUILDER'S DICTIONARY is a photo offset copy from the original two-volume set in the library of the Chief Historical Architect of the National Park Service. Reproduction, printing and binding were provided by Town House Press, Inc., 28 Midway Road, Spring Valley, New York. This reprint is a complete and unabridged copy of the original. A few of the plates have been reduced slightly and all have been placed as in the original copy rather than following the printed instructions to the binder. This reprint is made on Caslon acid-free long life natural paper and bound in Roxite Buckram. The title page and prefatory material were typeset on an Alpha Key phototypesetting system, and designed by Northlight Graphics, 6809 Dean Drive, McLean, Virginia.

Overall management of this project was provided by Nicolas F. Veloz, Jr.

This republication of THE BUILDER'S DICTIONARY was undertaken for The Association for Preservation Technology by The Foundation for Preservation Technology. The Association for Preservation Technology (APT) is an association of professionals active in the preservation of historic resources. From its inception in 1968, APT has been an international forum for the development of architectural preservation techniques in North America. The reprinting of THE BUILDER'S DICTIONARY follows the reprinting (in 1980) of Russell and Erwin's 1865 catalog of American hardware, and is another of APT's efforts, in addition to its quarterly BULLETIN, to make key documents available to professionals in the field for research and study.

The Foundation for Preservation Technology was incorporated in Washington, D.C., 1975, exclusively for educational, scientific and charitable purposes. The FPT provides financial support for those activities which advance the knowledge of early building practices and preservation technology.



VOL. I

To Face the Titles.



I. Devoto inv.

Terni Sculp.

To build, to plant whatever you intend
To rear the Column or y Arch to bend
To Swell the Tarras or to Sink y Grot
In all, let Nature never be forgot.

Pope.

THE Builder's Dictionary : O R, Gentleman and Architect's COMPANION.

Explaining not only the
TERMS of ART

In all the several
PARTS of ARCHITECTURE,

But also containing the
THEORY and PRACTICE

Of the

Various BRANCHES thereof, requisite to be known by

MASONS,		PLAISTERERS,		TURNERS,
CARPENTERS,		PAINTERS,		CARVERS,
JOINERS,		GLAZIERS,		STATUARIES,
BRICKLAYERS,		SMITHS,		PLUMBERS, &c.

Also Necessary Problems in

ARITHMETIC, GEOMETRY, MECHANICS, PERSPECTIVE,
HYDRAULICS, and other MATHEMATICAL SCIENCES.

Together with

The Quantities, Proportions, and Prices of all Kinds of MATERIALS
used in BUILDING; with DIRECTIONS for Chusing, Preparing,
and Using them: The several Proportions of the FIVE ORDERS of
ARCHITECTURE, and all their Members, according to VITRUVIUS,
PALLADIO, SCAMOZZI, VIGNOLA, M. LE CLERC, &c.

With RULES for the Valuation of HOUSES, and the EXPENCE calculated
of Erecting any FABRICK, Great or Small.

The Whole Illustrated with more than Two Hundred FIGURES, many of
them curiously Engraven on COPPER-PLATES: Being a Work of great
Use, not only to ARTIFICERS, but likewise to GENTLEMEN, and others,
concerned in BUILDING, &c.

Faithfully Digested from the most Approved Writers on these Subjects.

In TWO VOLUMES.

L O N D O N :

Printed for A. BETTESWORTH and C. HITCH, at the *Red-Lion* in *Pater-noster-Row*; and S. AUSTEN, at the *Angel and Bible* in *St. Paul's Church-Yard*,
M. DCC. XXXIV.

January 11. 173 $\frac{3}{4}$.

WE have perused these Two Volumes of the
Builder's Dictionary, and do think they con-
tain a great deal of useful Knowledge in the Build-
ing Business.

Nicholas Hawksmoor,
John James,
James Gibbs.

THE PREFACE.

A *ARCHITECTURE* is one of those Arts which Necessity has made universal: From the Time that Men first felt the Inclemencies of the Seasons, it had its Beginning; and accordingly it has spread wheresoever the Severities of the Climate demanded Shelter or Shade: It is to be traced in the *Indian's* Hut and the *Icelander's* Cave; and still shews, in those barbarous Parts of the Globe, from what mean Original it rose to its present Glory.

As Distress was the Parent of it, so Convenience was the first Object it regarded: Magnificence and Decoration were the Result of long Refinement, and designed to flatter the Ostentation of the Owners: Politeness is but a more delicate Term for Luxury; and was it not natural for Men to grow wanton with Ease and Affluence, all the Sciences in general had laid inactive, nor ever started into Being.

'Tis easy to conclude from hence, That *Convenience* should still be the Builder's first View: Every Structure is raised to answer some particular End; and the most obvious and simple Means are always the best to obtain it. When such a Plan as this is uniformly and consistently laid; when all its Uses may be comprehended at a single Glance, and all appear undeniably reasonable and perfect; then the Artist is at Liberty to add Grandeur and Elegancy to Strength and Propriety,

a

The P R E F A C E.

priety, and finish the Whole with the full Splendor of Beauty and Grace.

By this Division of *Architecture* into Beauty and Use, it will be demonstrable to every Reader, that 'tis partly an Art, and partly a Science; that the first is mechanical, and the last the Result of Genius and superior Understanding: One calls in all the Aid of Fancy and Imagination, grows poetical in Design, and picturesque in Decoration; the other lays down fix'd and stated Rules, proceeds in the same invariable Track of Reasoning, and comes always to the same Conclusions. Hence it happens, that many an excellent Workman has proved himself a mere Mechanick, and many a surprizing Genius, that he was ignorant of the very Principles of the Art he made it his Profession to understand. To make a thorough Master, both must be united; for the Propriety of a Plan is seldom attended to, and seldomer understood; and a glaring Pile of Beauty, without Use, but mocks the Possessor with a Dream of Grandeur he can never enjoy.

The Design of this DICTIONARY is chiefly for the Assistance of such, who study the Mechanical Part of Building, and will be of the greatest Service to all Professions that have any Relation to it: The Elements of the Art will be fully explained, and in so regular a Method too, that it can hardly be in the Power even of a Novice to mistake. Neither is it impossible that the most finish'd Artist, or most perfect Critick, should stand in need of its Help: It will serve, at least, as a kind of Remembrancer, or Common Place-Book, where all their Knowledge lies regularly digested, and may be referred to with Ease and Pleasure.

To do this more effectually, all the valuable Authors which have wrote on the Subject have been
examin'd,

The P R E F A C E.

examin'd, consulted, and reduced into Method and Consistency with each other: We may quote a great Variety of eminent Names; but as *Le Clerc* has been referred to the most, we shall content ourselves with his Authority only, and recommend the Steps he, in particular, has pointed out, as the surest Methods to attain to any Degree of Perfection in this Art.

ARITHMETICK is the first, as being the Ground-Work of Mensuration, either as to Extent or Solidity, as being the Medium of all Calculations, and the only Road to any Degree of practical Knowledge in the Mathematicks: For these Reasons, we have made no Scruple to add all the necessary common Rules, and some brief Examples for the Extraction of the Square and Cube Roots; as likewise the Use of several Instruments; such as Measuring by Scale and Compass, the Use of *Gunter's Line*, Sliding Rule, &c. Under this Head too we have added various Tables for calculating the Value of various Kinds of Work belonging to Building, according to their Dimensions, and at several different Prices: Which, though no Way of a Piece with the Theory of this Art, are of no small Use in the Practice.

GEOMETRY follows in the next Place, and is indeed the Foundation that all Students must build upon, since 'tis impossible to attain to any Perfection in *Architecture* without it: 'Tis *Geometry* that lays down all the first Principles of Building, that adjusts all Bearings and Proportions, and measures Points, Angles, and Solidities. In short, there is no being a Master of *Architecture*, without being perfect in all the Parts of *Geometry*; and he that is so, though he may err in Decoration, can never do the same, either in Strength or Proportion. To answer this important Purpose, we have not only inserted all such Articles of *Geometry* as are necessary to be known by the Architect,

The P R E F A C E.

test, but even such as may be of Use to Carpenters, Joiners, Masons, &c. containing, at once, the Definitions, Theorems, Problems, and their Demonstrations; and likewise the engrav'd Representations of the Figures so defined. And hence, we flatter ourselves, the young Practitioner will be much better able to form his Models, by making himself Master of these Rules, than by the most reasonable Notions which may result from his own uncertain Fancies and Conjectures.

MASONRY, or the Mechanical Means of raising Perpendiculars, turning Arches, erecting Bridges, and forming Stair-Cases, is another Branch of this Art, and must be understood with great Accuracy and Readiness; as being the Execution of the Whole which the Student desires to learn. On this Head, therefore, we have collected the best Instructions to be found, from heaving the Stones out of the Quarry, to their Arrangement in the Structure; and in regard little is to be found on *Bridges* in *Vitruvius*, or, beside *Palladio*, in almost any of the modern Architects, we have given an Extract from a *French Treatise of Bridges*, published by *M. Gautier*, Architect and Engineer to *Lewis the Fourteenth*.

LEVELLING, and HYDRAULICKS, are likewise of great Importance to the Builder: The first at once enabling him to understand good Situations, or amend them if they are otherwise: And the last, of course, directing the Conveyance of Water, the Draining of low Grounds, and teaching the whole Secrets of collecting Reservoirs, or afterwards employing them to the best Advantage. In short, on these depend both the necessary Use of Water for Family-Supply, and also all the beautiful Effects that can result from it in Gardens, by Basons, Fountains, Cascades, &c. On this Head, we have added a Description of the most useful Instruments for these Purposes, as
likewise

The P R E F A C E.

likewise the most approved Methods of employing them to Advantage.

MECHANICKS is another Essential in this noble Art. 'Tis by understanding their Power and Effect, that such Machines are contriv'd, as alone are able to raise up the heavy Materials to Buildings of any considerable Height, or empty Waters from a Bottom, or drain a Level, or force them upwards, as Art would direct, or Necessity require. And to answer these Purposes the better, we have not only annexed Definitions, Theorems, and Problems, which are the Fundamentals of this Study, but have likewise added Plates, with explanatory Figures, for the greater Ease and Facility of learning the Mechanical Powers, the Balance, Lever, Pulley, Screw, Wheel, and Wedge.

These, with the Art of Sketching and Drawing, are all the different Branches of Study which are necessary to form a Compleat Mechanical Architect. But when he is thoroughly initiated in them all, so as not to err, even in Principles or Practice, if he cannot add as much Knowledge more of his own, in their Use and Application, he will be fit for nothing more than the Overseer of a Work, or a Judge of the mere Methods to carry on and finish the Whole.

The Science of DESIGNING is still wanting to form a Great Master, or produce such Plans as would vie with the antient Beauties of *Greece* and *Rome*. But if this is not in the Genius, it is never to be learn'd: To be able to enter into this Secret, the Student must have great natural Parts; a noble and fruitful Imagination, a thorough Insight and Acquaintance with Beauty, and Judgment sedate and cool enough to form a just and delicate Taste. Without Taste, even Genius itself wanders blindfold, and spends itself in vain. Genius is, indeed, the first Quality of the Soul; but Taste must be added, or we shall censure the Wildness, instead of admiring

The P R E F A C E.

admiring the Beauty; we shall be dissatisfy'd with the Irregularity, instead of being pleas'd with the Magnificence.

But though Genius cannot be learn'd, it may be improv'd: And though the Gift of *Designing* is born with a Man, it may be methodized by Study and Observation.

The principal Points, therefore, that the *Designer* should have in view, are first Convenience, as has been hinted already, and then Beauty and Magnificence. With regard to Convenience, few Directions can be given, since it means no more than contriving all the Requisites belonging to your Plan, in the most clear and elegant Manner, and then laying out the Space they are to be ranged in with the most perfect Order and Oeconomy. As to Beauty and Magnificence, they are Themes never to be exhausted; and though many Volumes have been written on them already, as many more might still be added.

SIMPLICITY is generally understood to be the Groundwork of Beauty, and Decoration of Magnificence. 'Tis certain, the fewer Parts a Building is compos'd of, if they are harmoniz'd with Elegance and Proportion, the more beautiful it appears: The Eye is best satisfy'd with seeing the Whole at once, not in travelling from Object to Object; for then the Whole is comprhended with Pain and Difficulty, the Attention is broken, and we forget one Moment what we had observed another.

But a *Contrast of Figure* must be preserved even in the Midst of this Simplicity. 'Tis in Building, as in Musick; the Parts are various and disagreeing in themselves, 'till reconcil'd by the Skill and Judgment of the Master. A Sameness of Form betrays a Poverty of Imagination; and is the same in Architecture, as Dulness is in Writing: The Mind is glutted with

The P R E F A C E.

with it instantly, and turns away dissatisfy'd. It is therefore a principal Thing to be regarded by the Student, to design simply and variously at the same Time, and Beauty will infallibly be the Result of the Whole.

PERSPECTIVE is another grand Part of Designing; which demands the Master's most critical Regard, in as much as nothing contributes more to Grandeur and Beauty, if well understood; and nothing is understood with more Difficulty or Study. By Perspective, is commonly meant the thorough Inside Prospect of a Building: But if it cannot be applied with Propriety to the Art, we would take the Liberty of substituting the Painters Word *Keeping* in the Stead of it. For in all Buildings, as in Pictures, there must be one principal Figure, to which all the others must be subordinate; and from whence you must set out to examine the Parts, and to which you must return to determine of the Whole.

DECORATION, or Choice and Disposition of Ornaments, is the last grand Requisite to make a compleat Architect: And this depends partly on Genius, and partly on Fancy; but both must be under the Conduct of the severest Judgment and exactest Taste. In short, all Ornaments are ill-placed, that may be spar'd without being miss'd; as all empty Spaces are absurd, where Nakedness hurts the Eye, and Propriety would admit of Decoration.

We can't sufficiently recommend to all Persons, who build sumptuously, to calculate their Buildings according to the Point of Light from whence they are to be view'd: If they may, or should be seen from far, their Parts should be simple, great, and noble; if the Prospect is near, the Workmanship should be neat and little, that it may be seen and understood, as the Nature of its Situation will give Leave.

Upon

The P R E F A C E.

Upon the Whole, nothing but Nature, and a long Study of the antient and modern Structures, will enrich the Mind sufficiently to excel in this noble Art; and this *Dictionary* will be found a proper Key to explain their Beauties, as well as a needful Caution to avoid their Defects.

To conclude; We have nothing more to add, but our grateful Acknowledgments to those Gentlemen and Artists, who have favoured us with their Assistance in this useful Undertaking; and that we hope our Labours will lie secure from Censure at least, if they may not be judg'd altogether worthy of Applause.

Directions to the Binder, for placing the PLATES.

VOL. I.

- Plate I. II. at the End of Sheet K, facing it.
- III. in Sheet P, facing CHISSEL.
- IV. in Sheet Y, facing DOORS.
- V. in Sheet Z, facing E A.
- VI. in Sheet Aa, facing FLUIDS.
- VII. in Sheet Bb, facing *Vulgar* FRACTIONS.
- VIII. in Sheet Ee, facing GRATIFICATION.
- IX. in Sheet Ee, facing GRAVITY.
- X. in Sheet Ff, facing GROIN.
- XI. in Sheet Gg, facing HIP-ROOF.
- XII. in Sheet Gg, following Plate XI.
- XIII. in Sheet Ii, at the End.
- XIV. in Sheet Ii, at the End.
- XV. in Sheet Ii, at the End.

VOL. II.

- XVI. in Sheet H, facing ORLE.
- XVII. in Sheet I, facing PARABOLICK.
- XVIII. in Sheet K, facing PERSIAN ORDER.
- XIX. in Sheet M, facing POINT.
- XX. in Sheet N, facing PUMP.
- XXI. in Sheet N, facing QUADRANT.
- XXII. in Sheet O, facing RIDES.
- XXIII. XXIV. XXV. XXVI. in Sheet P, facing RUDENTURE.
- XXVII. in Sheet S, facing STEPS.
- XXVIII. in Sheet Y, facing TRIGLYPHS.
- XXIX. in Sheet Bb, facing VAGINA.
- XXX. in Sh. Cc, facing WAINSCOT.
- XXXI. in Sheet Dd, facing WATER.
- XXXII. in Sheet Gg, facing WEDGE.
- XXXIII. in Sheet Gg, facing WINDMIL.
- * Plate facing TRIANGLE.

T H E

THE NEW
 BUILDER'S *Dictionary* :
 OR,
 Gentleman's *and* Architect's
 COMPANION.

A B

ABACUS [is *Latin* of *Ἀβάξ*, Gr. which signifies several Things; as a square Trencher, and sometimes a Cup-board, &c.] But in Architecture, *Abacus* is the upper Member of the Capital of a Column, serving as a kind of Crowning, both to the Capital and the whole Column.

Others define it to be a square Table, List, or Plinth, in the upper Part of the Chapters of the Columns, especially of those of the *Corinthian* Order, serving instead of a *Drip* or *Corona* to the Capital, supporting the nether Face of the Architrave and whole Trabeation.

In Columns of the *Corinthian* Order, it represents a kind of square Tile covering a Basket,
 VOL. I.

A B

suppos'd to be encompass'd with Leaves.

In the *Tuscan*, *Doric*, and ancient *Ionic*, it is a flat square Member, well enough resembling the original Title; whence it is called by the *French Tailloir*, i. e. a Trencher, and by the *Italians Credenza*.

In the richer Orders, it loses its native Form, the four Sides or Faces of it being arch'd or cut inwards with some Ornament, as a Rose, or other Flower, a Fish's Tail, &c. in the Middle of each Arch. Others say, that in the *Corinthian* and *Composite*, it is compos'd of an *Ovolo*, a *Fillet*, and a *Cavetto*.

But some Architects take other Liberties, both as to the Name, Place, and Office of the *Abacus*.

B

Thus

Thus in the *Tuscan* Order, where it is the largest and most massive, as taking up one Third of the whole Capital, and is sometimes call'd the Dye of the Capital.

In the *Doric*, it is not always the uppermost Member of the Capital, it having a Cymatium frequently placed over it.

In the *Ionic*, some make it a perfect Ogee, and crown it with a Fillet; or 'tis compos'd of a *Cima Reversa*, and Fillet only.

Andrea Palladio, in the *Tuscan* Order, calls the Plinth above the (Echinus) or Boulton, *Abacus*; which, as he says, is commonly called a *Dado*, or *Dye*, from its Form, and is one Third of the whole Height of the Capital.

In the *Ionic* Order, he defines it to be an Ogee, with a Fillet over it; which is one Third of the whole Height of the Capital, and *M. Mansueti* after him does the same.

He also calls the *Plinth* above the *Boulton* of the Capital of the *Doric* Order *Abacus*, and places a Cymatium above it for the uppermost Member of the Capital.

He also describes the *Abacus* of the *Corinthian* Order to be one seventh Part of the whole Capital, divided into three Parts, the uppermost of which is a Boulton, and one Third of the next Third below is the Fillet, and the remaining Part below, which is one and two Thirds, is the *Plinth* of the *Abacus*.

Besides this, the *Abacus* is not constantly restrain'd to the Capital of the Column, *Scamozzi* using the Name *Abacus* for a concave Moulding in the Capital of the *Tuscan* Pedestal.

Vitruvius, and others after him, who give the History of the Orders, inform us, that the *Abacus* was originally intended to represent a square Tile laid over an Urn, or rather a Basket. See *Acanthus*.

ABBREUVOIR } [*Abbren-*
ABREVOIR } *voir*, in
French, signifies a Watering-Place.] In Masonry it signifies the Joint or Juncture of two Stones, or the Interstice or Space left between to be filled up with Mortar or Cement.

ABBUTTALS } the But-
ABUTTALS } tings and
Boundings of a Piece of Land, expressing on what other Lands, Streets, Highways, &c. the several Extremes thereof abutt or terminate.

ABSCISSA } [in *Conicks*] is
ASSCISSE } the Part of the
Diameter of a Curve, or transverse Axis of a Conic Section, intercepted between the Vertex, or some other fix'd Point, and a Semi-ordinate.

ABUNDANT NUMBERS are such, whose Quota-Parts added together, make more than the whole Number; as of those of 12, make more than the whole Number they are Parts of, whose Quota-Parts being 1; 2, 3, 4, and 6, being added together, make 16; and so the Parts of 20 make 22, &c.

ACANTHUS [of *'Ακανθος*, *Gr.* a Thorn, being so called, as being prickly, or of the Thistle Kind. It is called in *Latin*, *Branche Ursina*, in *English* Bear's Breech, on account of some supposed Resemblance it bears thereto: And also *Branc Hircina*, i. e. Goat's

Goat's-Horn, because its Leaves bend and twist somewhat like a Goat's Horn.]

Acanthus, in Architecture, is an Ornament in the *Corinthian* and *Composite* Orders, being the Representation of the Leaves of the Plant in the Capitals of them.

Callimachus, an ingenious Statuary of *Athens*, is said to have been the Inventor of this Ornament, on the Occasion following: An *Athenian* Old Woman happening to place a Basket, covered with a little Tile, over the Root of an *Acanthus*, which grew on the Grave of a young *Corinthian* Lady, the Plant shooting up the following Spring, encompass'd the Basket all around, till meeting with the Tile, it curled back in a kind of Scrolls; He passing by, and observing it, immediately executed a Capital on this Plan, representing the Tile by the *Abacus*, and the Leaves of the *Acanthus* by the Volutes or Scrolls; and the Basket (*Tambour*, as the *French* call it) by the Vase or Body of the Capital.

There are two Kinds of the Plant *Acanthus*; the one wild, and full of Prickles; and the other of the Garden, without Prickles. The *Greek* Mafons adorn'd their Works with the Garden *Acanthus*, and the *Gothic* Mafons with that of the wild; representing it not only in their Capitals, but also in other Ornaments.

Garden *Acanthus* is more indented than the wild, and carries a near Resemblance to Parsley, or Smalage, as it is found represented in the *Composite* Capitals of *Titus*, and *Septimius Severus* at *Rome*.

These Leaves make the principal Characters in distinguishing the two richest Orders from the rest; and these two Orders are distinguished from each other by their different Number and Arrangement.

ACCELERATED Motion [in *Mechanicks*] is the Increase of Velocity in a moving Body.

The Motion of falling Bodies is an *accelerated Motion*; and supposing the Medium they fall through, *i. e.* the Air void of Resistance, the same Motion may be considered as uniformly accelerated.

ACCELERATION is the same as *accelerated Motion*, and is chiefly used of heavy Bodies, tending to the Center of the Earth by the Force of Gravity.

It is evident from various Considerations, that natural Bodies are accelerated in their Descent: And it is actually found, that the greater Height a Body falls from, the greater Impression it makes, and with the greater Violence does it strike the Thing it falls upon.

ACCESSIBLE HEIGHT [in *Geometry*, &c.] is either that which may be mechanically measur'd, by applying a Measure to it, or it is a Height whose Base and Foot may be approached to, and a Distance measured thence on the Ground.

ACCIDENTAL POINT [in *Perspective*] is a Point in the horizontal Line, where Lines parallel to one another, though not perpendicular to the Representation, meet.

ACCLIVITY, the Steepness or Slope of a Line or Plane inclining to the Horizon, reckon'd

A C

upwards; as the *Ascent* of an Hill is the *Acclivity*, and, on the contrary, the *Descent* is the *Declivity*.

ACCOMPANIMENT, something attending on, or added to another, by way of Ornament, or for the sake of Symmetry, or the like.

ACERRA, among the *Romans*, a kind of Altar erected near the Gate of a Person deceas'd, on which his Friends and Acquaintance daily offered Incense till the Time of his Interment.

ACCOUSTICKS [*Ἀκροῦστικὰ* of *ἀκρόω*, *Gr.* to hear] the Doctrine or Theory of Sounds.

Dr. Hook says, it is not impossible to hear the lowest Whisper that can be made to the Distance of a Furlong; and that he knows a Method to hear any Person speak through a Brick Wall of three Foot thick. See *Whispering-Place*.

ACROTERIA [*Ἀκροτήρια*, of *Ἀκρος*, *Gr.* the Extremity of any Thing] small Pedestals, usually without Bases, placed on Pediments, and serving to support Statues.

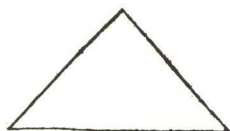
Those at the Extremes ought to be half the Height of the *Tympanum*, and that in the Middle, according to *Vitruvius*, one eighth Part, or more.

ACROTERIA also are sometimes used to signify Figures, either of Stone or Metal, placed as Ornaments or Crownings on the Tops of Temples, or other Buildings.

Sometimes the Name is used to signify those sharp Pinacles or spiry Battlements, which stand in Ranges about flat Buildings, with Rails and Ballusters.

A E

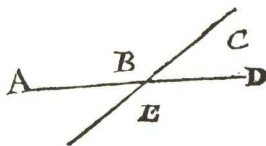
ACUTE Angled Triangle, is one whose three Angles are all



alike; and is also called an *Oxigonous Angle*, as in the Figure.

ACUTE Angular Section of a Cone, a Name by which Ancient Geometricians called the *Ellipsis*.

ADJACENT Angles are made by continuing out one Side



of an Angle; whence adjacent Angles are contiguous, but not on the contrary.

ADIT, the Shaft or Entrance into a Mine.

ADYTUM [*Ἀδυτον*, of a Priv. and *εἶναι*, *Gr.* to enter] a secret or retired Place in the Pagan Temples, where Oracles were given; and into which, none but the Priests were permitted to enter; in Imitation of the *Sanctum Sanctorum* of the *Jewish Temple*.

AERIAL, consisting of the Air, or something that has a Resemblance to it.

AERIAL Perspective, is that which is represented both weak and diminish'd, in Proportion to the Distance from the Eye.

It is founded on this, That the longer a Column of Air an Object

ject is seen through, the weaker do the visual Rays emitted from it affect the Eye.

The Object of Aerial Perspective is chiefly Colours of Objects, whose Force and Lustre it takes off more or less, to make them appear as if more or less remote.

AGEOMETRICAL, Ungeometrical, or defective in Point of Geometry.

AJUTAGE [in Hydraulicks] Part of the Apparatus of an artificial Fountain; being a sort of *Jet-d'eau*, or kind of Tube fitted to the Mouth or Aperture of a Vessel, through which the Water is to be play'd, and by it determin'd into this or that Form or Figure.

ALABASTER, a kind of Stone softer than Marble; but harder than Plaister of *Paris*; if it be so soft, as that it can be cut, it is called *Gypsum*.

It is found or digged in the *Indies*, *Aegypt*, *Syria*, &c. There is also some found in *Lincolnshire* and *Staffordshire*.

It is found of several Colours; some extreamly white and shining, which is the most common; some red, like Coral; and some of the Colour of the *Onyx*; which thence is called *Onyx*, though it differs very much from it in Nature or Quality.

Its Use is chiefly in making Monuments in Churches, &c. where there are many Figures in Relief, or Bass-Relief, &c. carved: It is also used for carving Coats of Arms cut in Relief, to be set in Brick or Stone, in the Fronts of Houses.

Alabaster cuts very smooth and easy, and is much used by Scul-

ptors in making little Statues, Vases, Columns, &c.

It is also used like Plaister of *Paris*, being first burnt and calcin'd; then mix'd up with Water to a thin Consistence; which being afterwards cast into a Mould, it very readily coagulates into a solid Body.

ALCOVE [of *Alcoba*, *Spanish*, of *Elkans*, *Arabick*, a Cabinet; or of *Elcobat*, a Tent, or Place to sleep in] is a Recess or Part of a Chamber, separated by an Estrade or Partition of a Column and other correspondent Ornaments; in which is placed a Bed of State, and sometimes Seats to entertain Company. The Bed is frequently raised up two or three Ascents, with a Rail at the Feet. These *Alcoves* are frequent in noble Houses in *Spain*, and other Places.

ALDER is an Aquatick Tree, too well known to need any Description.

In former Times, large *Alders* were used for building Boats, and now they are very much esteem'd for such Parts of Works which lie continually under Water; where it will become as hard as Stone; but if suffer'd to lie some Times exposed to the Weather, and at others to lie under the Ground in watry Places, it will decay in a little Time.

We are inform'd by *Vitruvius*, that the *Morasses* about *Ravenna* in *Italy*, were piled with *Alder* Timber, in order to build upon; for which Use he highly commends it.

And the *Rialto*, that famous Bridge at *Venice*, which passes over the Grand Canal, and bears

a vast Weight, is built upon Piles of this Wood.

Trunks of Trees or Poles of this Wood, are extraordinary useful in making Pumps, Water-Pipes, &c.

They are used (in the Country) for Water-Pipes for the Conveyance of Water through Bays and Dams; and also for Water-Pipes for conveying Water from any Spring, to supply a House with it; and large Poles or Trees of this Wood are used for Ground Guts, for conveying Water out of Stews. These Poles are about eight or ten Inches diameter, and the Cavity in them about four, or four and a half; for boring and fitting up of which Size, they give about 3s. 6d. per Rod for Workmanship.

But for Water-Pipes, the Poles need not be above four or five Inches diameter, and the Cavity about an Inch and quarter, or one Inch and half diameter.

As to the Method of boring Alder Poles. These Poles being laid on Horses or Tressels of a fit Height, to rest the Augur upon while they are boring, they set up a Lath, to turn the least End of the Poles, to fit them to the Cavities of the great End of the others: The Lath being set up, and the Poles cut to the Lengths, they will conveniently hold, viz. eight, ten, or twelve Foot. They turn the small Ends of the Poles about five or six Inches in Length, to the Size they intend to bore the bigger Ends, about the same Depths, viz. five or six Inches (this is designed to make a Joint to shut each Pair

of Poles together, the concave Part being the Female-Part, and the other Part, the Male of the Joint.) In turning of the Male Part, they turn a Channel in it, or a small Groove at a certain Distance from the End; and in the Female-Part, they bore a small Hole to fit over this Channel.

This being done, they bore the Poles through; and to prevent them from boring out at the Sides, they stick great Nails at each End, to be a Guide to them in boring strait through; though they usually bore them at both Ends; so that if a Pole be crooked one Way, they can bore it through and not spoil it.

The Poles being bored, they form them into Pipes in the Ground; in order to which, they dig a Trench, and prepare it with Clay, to ram them in the Female Part, which is first bound with an Iron Ring round it, to prevent its Splitting; afterwards they drive in the Male Part till the Groove in it is just under the Hole; and pour melted Pitch hot into the Hole, in the Female Part, which will flow round in the Groove which was turned in the Male Part: By this Means, the Junc-tures are render'd very staunch and close; and in this Manner they proceed till they have laid all the Poles or Pipes in their Order.

As to the Charge of preparing these Pipes: For the Workmanship only, they usually require about 2s. 6d. or 3s. per Rod, 1s. for boring and fitting them; but the Charge of all the Work and Materials, Boring, Digging the Trench, Laying and Ramming in the Clay, &c. and also

also the Charge of the *Poles*, *Clay*, *Pitch*, and *Iron Rings*, will amount from 4s. to 6s. per Rod, according as the Materials can be procur'd.

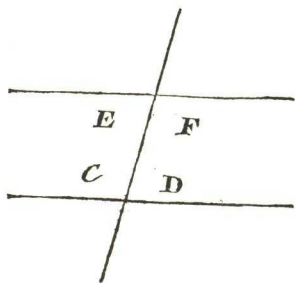
ALGEBRA is a Method of resolving Problems by Means of Equations.

ALIQUANT Part [in Arithmetick] is that which cannot measure or divide any Number exactly; but that there will be at last some Remainder, as 5 is an *Aliquant Part* of 12; for being taken twice, it falls short, and if taken three Times, it exceeds 12.

ADIQUOT Part [in Arithmetick] is such a Part of a Number as will measure it exactly without any Remainder, as 3 is an *Aliquot Part* of 9, and 4 of 12.

ALLEY [in Perspective] is that which is larger at the Entrance than at the Issue; to give it a greater Appearance of Length.

ALTERNATE Angles are the internal Angles made by a Line cutting two Parallels, and lying on the opposite Sides of



the Cutting Line; the one below the first Parallel, and the other above the second, as the Angles E and D and FC.

ALTERNATE Proportion, or *Ratio* [in Arithmetick] is

the assuming an Antecedent to an Antecedent, as the Consequent to the Consequent; as if AB, CD, then by *alternate Proportion*, will AC, BD.

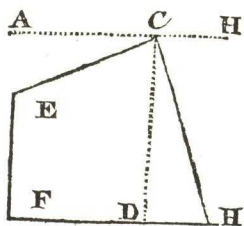
ALTERNATION is used by some for the different Changes or Alterations of Order in any Number of Things proposed.

This *Alternation* is easily found by only multiplying continually all the Numbers beginning at Unity: As suppose it be required to know how many Changes can be rung upon five Bells; you need only write down 12345, and then multiply all those Numbers continually one into another, and the last Product will be 120, the Number of Changes.

ALTIMETRY [of *alta* high Things, and *metiri* to measure] the Art of taking or measuring of Altitudes or Heights, whether accessible, or inaccessible.

ALTITUDE, the third Dimension of Body, called also Height, or Depth.

The **ALTITUDE**, or **HEIGHT** of Figures, is the parallel Distance between the Top of a Figure and the Base. So the



Height of the Trapezium CE
FH is the Perpendicular CD;
B 4 because

because it is in the nearest Distance between the parallel Lines AH, the Top, and FDH, the Base. And it is the same of other Figures; as a Triangle, Hexagon, &c.

AMBLIGONIAL [in *Geometry*] Obtuse-angular.

AMBLYGONOUS Angle, is an Obtuse Angle, or Angle consisting of more than 90 Degrees.

AMPHIPROSTYLE [in *Antient Architecture*] a Kind of Temple which had four Columns in the Front, and the same Number in the Face behind.

AMPHITHEATRE [of *Ἀμφιθεάτρον*, of *ἀμφι*, on both Sides, and *θεάομαι*, I behold, *Gr.*] and is a spacious Edifice or Building in either a circular or oval Form, having its Area encompassed with Rows of Seats arising gradually one above another; where Spectators might sit to behold Spectacles, as Stage-Plays, Combats of Gladiators, and those of wild Beasts, &c.

The Theatres of the Antients were built in the Form of a Semicircle, only exceeding a just Semicircle by one fourth Part of the Diameter; and the *Amphitheatre* is nothing else but a double Theatre, or two Theatres join'd together; so that the longest Diameter of the *Amphitheatre*, was to the shortest, as one and a half to one.

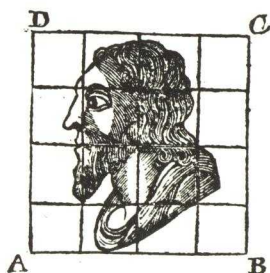
The *Amphitheatre* of *Vespasian*, call'd the *Coliseum*, that at *Verona* in *Italy*, and that at *Nismes* in *Languedoc*, are the most celebrated that we have now remaining of Antiquity.

Pliny makes mention of an *Amphitheatre* built by *Curio*, which turn'd on large Iron Pivots; so that of the same *Amphitheatre*, two several Theatres were made occasionally, on which different Entertainments were exhibited at one and the same Time.

ANABATHRUM [*Ἀναβαθρον*, of *ἀναβαίω* to ascend, *Gr.*] a Place that is ascended to by Steps.

ANALOGY [in *Geometry*, &c.] is the Comparison of several Ratio's together; and is the same as Proportion.

ANAMORPHOSIS, or *Monstrous Projection of an Image*, [in *Perspective*,] is the Deformation of an Image on a Plane, or the Superficies of some Body, which seen at a certain Distance, will appear formous.



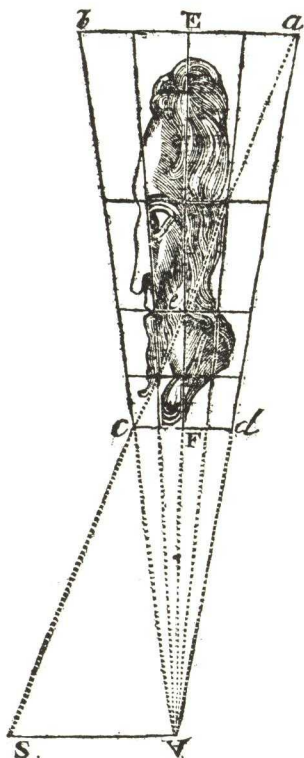
If it be required to delineate a *Monstrous Projection* on a Plane, proceed thus;

First, Make a Square ABCD, (called the *Craticular Prototype*,) of a Bigness at Pleasure, and divide the Side AB into a Number of equal Parts, that so the said Square may be divided into a Number of *Areola's*, or lesser Squares.

Secondly,

AN

Secondly, In this Square let the Image to be represented deform'd, be drawn.



Thirdly, Draw the Line $ab =$
A B, and divide it into the same
Number of equal Parts as the
Side of the *Prototype* A B is di-
vided.

Fourthly, in E, the Middle thereof, erect the Perpendicular EV, so much the longer, as the Deformation of the Image is so be greater.

Fifthly, Draw VS perpendicular to EV , so much less in Length.

AN

Sixthly, From each Point of Division, draw straight Lines to V, and join the Points *a* and S, as also the Right Line *a* S.

Seventhly, Through the Points d, e, f, g , draw Right Lines parallel to ab ; then will a, b, c, d , be the Space that the monstrous Projection is to be delineated in, called the *Craticular EType*.

Eighthly, In every Areola, or small Trapezium of this Space *abcd*, let there be drawn what appears delineated in the correspondent Areola of the Square *ABCD*; and by this Means you will obtain a deform'd Image, which will appear formous to an Eye distant from it by the Length *FV*, and raised above it the Height *VS*.

Ninthly, It will be very diverting to manage it so, that the deform'd Image does not represent a mere Chaos; but some other Image different from it, which by this Contrivance shall be deform'd.

As there has been seen a River with Soldiers, Waggon, &c. marching along the Side of it: so drawn, that being look'd at by an Eye in the Point S, appear'd to be the satyirical Face of a Man.

Tenthly, An Image may be de-
form'd mechanically; if you place
the Image, having little Holes
here and there made in it with a
Needle or Pin, against a Candle
or Lamp, and observe where the
Rays, going through these little
Holes, fall on a Plane or Curve
Superficies; for they will give the
correspondent Points of the
Image deform'd, by which Means
the Deformation of the Image
may be compleated.

ANCHORS

A N

ANCHORS [in Architecture] a sort of Carving something resembling an *Anchor*, or Arrow-Head. They are commonly placed as Part of the Enrichments of the Boultings of Capitals of the *Tuscan*, *Doric*, and *Ionic* Orders; and also of the Boultings of Bed-Mouldings of the *Doric*, *Ionic*, and *Corinthian* Cornices; these *Anchors* and Eggs being carved alternately throughout the whole Buildings.

ANCONES are the Corners or Coins of Walls, Cross-Beams, or Rafters. *Vitruvius* calls the Consoles (a sort of Brackets, and Shouldering-Pieces) *Ancones*.

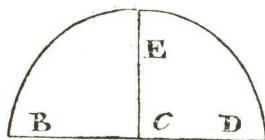
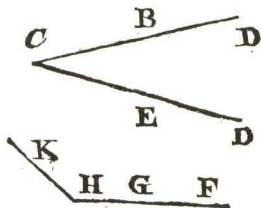
An **ANGLE** is an indefinite Space, terminated by two Right

A N

both their Lengths, without forming any *Angle*. And on the contrary, if any Right Line meet another Right Line in any different Position, they will constitute an *Angle* at their Point of Meeting.

An **ANGLE** is signified by three Letters, of which the middlemost always denotes the *Angle*; so in the Case of the two *Right Angles* in the Figure **RIGHT ANGLE**, the one is denoted by the Letters **ECD**, and the other by the Letters **ECB**.

A **RIGHT ANGLE** is constituted by the Meeting of two Right Lines, with an equal Inclination, that is, if a Line, as **EC**, meet another Line, as **DB**, and inclines no more towards



Inclining Lines which meet together in one Point, as the Right Lines **DB**, and **DE**; which being continu'd in their own Positions, will meet at **C**, and by that generate an *Angle*.

So likewise the Right Lines **FG**, and **K**, being continu'd, will meet at **H**, and form an *Angle* also.

But if two Lines meet in such a Manner, as to have no Inclination the one to the other, they will generate a Right Line, and a Right Line equal to

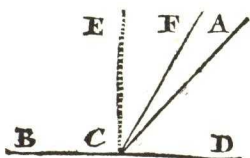
DB, than it does towards **B**, but stands directly square between both, then the Angle is called a *Right Angle*, and the Line **EC** is therefore called a Perpendicular Line to the Line **DB**.

The Line **EC** standing upon the Line **BD**, at **C**, is perpendicular thereto; because if you describe a Semicircle with any Radius, as **BED**, the Arch **BE** will be equal to the Arch **DE**; and since that both Arches are equal to each other, and to a Semicircle also, being taken together, it therefore follows, that both the Angles on either Side are equal, and are therefore called *Rect* or *Right Angles*.

Now

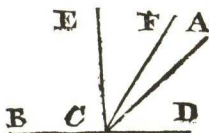
Now since the Semicircle BED contains 180 Degrees, being just the Half of 360 Degrees, contain'd in every whole Circle, and is equally divided in C, by the perpendicular Line EC; it therefore follows, that the Angles BEC, and DEC, are equal to each other, and must each consist of 90 Degrees; therefore a Right-angled Triangle is that whose Arch contains 90 Degrees precisely.

ACUTE ANGLE is an Angle whose Inclination is nearer than a Right Angle; so that when any two Lines incline nearer to one another than DC



doth to EC, as the Lines FC and DC, or AC and DC, then by their Meeting they form sharper Angles than the Right Angle ECD, and are therefore all called *Acute Angles*.

OBTUSE ANGLE is an

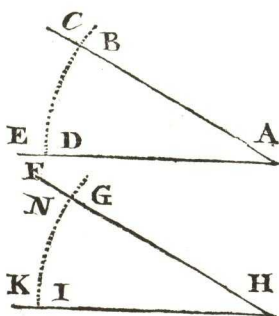


Angle constituted by the Meeting of two Right Lines, whose

Inclination is greater from one another, than the Lines of the Right Angle, as the Angles made by the Meeting of the Lines FC and CB, or AC and EB, by which they form Angles that are more blunt than the Right Angle, and therefore are called *Obtuse Angles*.

To make the Angle FHK equal to the Angle CAE.

First, On the given Angle A, with any Opening of the Compasses, describe an Arch as BD; and then having drawn a Right Line at Pleasure, as HK, on any of its Ends, as H, with the Opening AD describe the Arch IG.

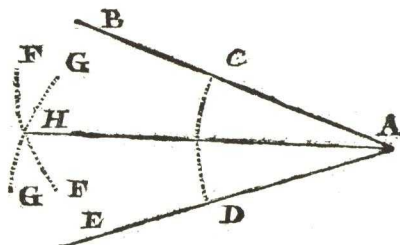


Secondly, Make IN equal to DB, and then from H, through N, draw the Right Line HF, which completes the Angle FHK = the given Angle CAE, as required.

A N

A N

To divide the *Angle* BAE into two equal Parts by the Right Line AH.

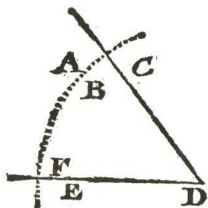


First, On the Point A describe an Arch of a Circle of any Radius, as CD; and with the same Opening of the Compasses, on the Points C and D, describe the Arches GG and FF, intersecting each other in H.

Secondly, From the angular Point A, draw to H the Right Line AH; which will divide the Angle into two equal Parts, as required.

The *Quantity* or *Measure* of an *Angle*, is the Arch of a Circle described on the angular Point, intercepted between the two Sides of that Angle.

To make an *Angle* of any given Magnitude, suppose 50 Degrees.

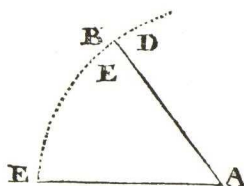


First, Draw a Line at Pleasure as FD; then take 60 Degrees from your Line of Chords, and on one End thereof, as at D, describe an Arch, as EC.

Secondly, Take from your Line of Chords 50 Degrees, the Quantity of the given *Angle*, and set it on the Arch from EC to EB; then drawing the Right Line DA from A through B, it will complete the Angle required.

The *Complements* of *Angles* are the same as the *Complements* of *Arches*, because their *Quantities* are measured by *Arches* of *Circles*.

The *Angle* BAE being given, to find its *Quantity*,



First, Take 60 Degrees from your Line of Chords, and with that Distance, on the angular Point A, describe the Arch FED.

Secondly, Take the Arch EF in the Compasses, and applying that Extent upon your Line of Chords, from the Beginning of it, the extended Point of the Compasses will fall upon the Number of Degrees and Minutes, which the

the *Angle* contains, viz. 60 Degrees, 00 Minutes.

ANNELETS } [of *Annulus*
 ANNULETS } a Ring, *L.*
 are small square Members in the *Doric* Capital, under the Quarter-Round, &c.

Annulets are used in Architecture to signify a narrow flat Moulding, (of which see *Capital*;) which is common to divers Places of the Columns, as in the Bases, Capitals, &c.

It is the same Member which *M. Mauclerc*, from *Vitruvius*, calls a *Fillet*; and *Palladio*, a *Listel*, or *Cincture*; and *M. Brown*, from *Scamozzi*, a *Supercilium*, a *List*, *Tinea*, *Eye-Brow*, *Square*, and *Rabit*.

ANTA [in Architecture] is used by *M. Le Clerc* for a kind of Shaft of a Pilaster, without Base or Capital, and even without any Moulding.

ANTÆ, Pillars adjoining to a Wall. Vide *Paraſtata*.

ANTE-CHAMBER } An
 ANTI-CHAMBER } outer Chamber, before the principal Chamber of an Apartment, where the Servants wait, and Strangers ſtay till the Perſon to be ſpoken withal is at Leiſure, &c.

2. *As to its Proportions*: A well-proportion'd *Ante-Chamber* ought to be in Length the Diagonal-Line of the Square of the Breadth, and not to exceed the Breadth and half at moſt.

3. *As to their Height*: They are made either arched or flat; if they are flat, their Height ought to be, from the Floor to the Joists, two third Parts of their Breadth. But if you have a Mind to have it higher, divide the Breadth into ſeven Parts, and take five of

them for the Height. Or 'eſſe divide the Breadth into four Parts, and take three of them for the Height.

In large Buildings, the *Ante-Chamber*, *Hall*, and other Rooms of the firſt Story, may be arched, which will render them handſome, and leſs ſubject to Fire: And in ſuch Buildings, the Height may be five Sixths of the Breadth, from the Floor to the Bottom of the Key of the Arch.

But if this Height ſhall be thought too low, you may make the Height ſeven Eighthths of the Breadth. Or it may be eleven Twelfthths, which will render it yet more ſtately.

4. *Of their Situation*: *Ante-Chambers*, &c. ought to be ſo ſituated, that they may be on each Side of the Entry, and of the *Hall*. And this likewiſe ought to be obſerved, that thoſe on the Right Hand may answer, and be equal (or nearly ſo) to thoſe on the Left; to the End, that the Buildings may, on all Sides, bear equally on the Roof. See *Halls*.

ANTERIOR, before another, in reſpect to Place; in which Senſe the Term ſtands oppoſite to *Poſterior*.

ANTICK [in Sculpture and Painting] is uſed to ſignify a confuſed Compoſure of Figures, of different Natures and Sexes, &c. as of Men, Beaſts, Birds, Flowers, Fiſh, &c. And alſo ſuch-like Fancies as are not to be found in Nature.

It would be tedious to enumerate all the *Antick* Forms and Fancies by which the Heathens reſented their ſeveral Gods, and their Poets, Painters, and Sculptors deſcribed them.

They

They had also strange and monstrous Figures of human Creatures, (and so represented them in Sculpture, &c.) as of Centaurs, half Men and half Horses; Sagitairs, half Men and half Bulls; Syrens, or Mermaids, half Women and half Fish; Harpies, half Women and half Birds; Griffins, half Beast and half Birds; Dragons, Part Serpents and Part Birds; the Spread-Eagle with two Heads; and many other of the like Nature. They also represented divers Sorts of Flowers and Fruits growing on the same Plant, &c. and many such like Fictions, which we have reason to believe are not to be found in Nature; though the Belief of their Existences hath been propagated by Poets, &c. upon account of their Fitness to be made use of in the Way of Similitude.

These Sorts of Representations the *Italians* call *Grotesca*, and the *French* *Grotesque*; which signifies comical, pleasant, apt to make one laugh; also ridiculous; and their Word *Grotesques* signifies idle, foolish Fancies.

ANTICUM, a Porch before a Door, a Fore-door, a *Hatch*, &c.

ANTIPAGMENTS, Ornaments or Garnishings in Carv'd Work, set on the Architrave, (Jaumbs, Posts, or Puncheons of Doors,) whether of Wood or Stone, after the *Latin* antique Word *Antipagmenta*.

ANTIQUE, something that is ancient

The Term is chiefly used by Architects, Sculptors, Painters, &c. who apply it to such Pieces of Architecture, Sculpture, Painting, &c. as were made at the

Time when their Arts were in their greatest Perfection among the antient *Greeks* and *Romans*, viz. between the Time of *Alexander the Great*, and that of the Emperor *Phocas*, when *Italy* became over-run by the *Goths* and *Vandals*, about the Year 600, about which Time the noble Arts were extinguisht.

Thus we say an *Antique Building*, or a Building after the *Antique*; an *Antique Bust*, or *Bass Relievo*, *Antique Manner*, *Taste*, &c.

ANTIQUÉ, is sometimes even contradistinguished from *Antient*, which denotes a lesser Degree of Antiquity, when the Art was not in its utmost Purity.

Thus *Antique Architecture* is frequently distinguished from *Antient Architecture*.

Also some Writers use the compound Word

ANTIQUO MODERN, in speaking of old *Gothic* Churches, to distinguish them from those of the *Greeks* and *Romans*.

APERITIONS ? [from the
APERTURES } *Latin aperio*, to open, signifies Openings.]
In Architecture the Words are used to signify Doors, Windows, Stair-Cases, Chimneys, Outlets and Inlets for Smoke, Light, &c. which ought to be as few in Number, and moderate in Dimensions, as possible, it being a Rule in Architecture that all Openings are Weakenings; nor must they be made too near the Angles of the Walls; for indeed it would be a great Solecism to weaken that Part which ought to strengthen all the rest.

APERTURE, the Opening of any Thing, or a Hole, Cleft, or vacant Place, in some other-wise

A Q

wife solid or continuous Subject.

APERTURE [in *Geometry*] is used for the Space left between two Lines, which mutually incline towards each other, to form an Angle.

APHORISM [*ἀφορισμός*, of *ἀπορίω*, Gr. to select] is a Maxim, general Rule, or Principle of a Science.

APOPHYGE [of *Ἀποφυγή*, Gr. Flight or Escape; whence the *French* call it *Escape*, *Congee*, &c.] In *Architecture* it signifies that Part of a Column where it begins to spring out of its Base, and shoot upwards.

The *Apophyge*, in its Original, was no more than the Ring or Ferril heretofore fastened at the Extremities of wooden Pillars, to keep them from splitting, which afterwards was imitated in Stone-Work.

APPEARANCE [in *Perspective*] is the Representation or Projection of a Figure Body, or the like Object, upon the Perspective Plane.

APPROXIMATION [in *Arithmetick*] a continual Approach nearer still, and nearer to a Root or Quantity sought, without a Possibility of ever arriving at it exactly.

AQUEDUCT [*Aqueductus*, q. d. *Ductus Aquæ*, L.] a Conveyance made for carrying of Water from one Place to another.

It is a Construction of Stone or Timber, made on uneven Ground to preserve the Level of the Water, and convey it by a Canal from one Place to another.

A R

Some *Aqueducts* are under Ground, and others rais'd above it, supported by Arches.

The *Romans* were extraordinary sumptuous and magnificent in their *Aqueducts*, some of which extended 100 Miles.

Frontinus, who had the Direction of them, informs us of nine which emptied themselves through 13,514 Pipes, of an Inch Diameter. And

Blasius has computed that the City of *Rome* received from these *Aqueducts* no less than 500,000 Hogheads of Water in twenty-four Hours Time

The *Aqueduct* built near *Maintenon*, for carrying the River *Bure* to *Versailles*, is the greatest in the World. It is in Length 7000 Fathoms, and its Elevation 2560 Fathoms, containing 242 Arcades.

AQUATICK, living, breeding, or growing about the Water; as Animals, Plants, Trees; as *aquatick Trees*, are such as grow on the Banks of Rivers, Marthes, Ditches, &c.

ARABESQUE } something
ARABESK } done after the Manner of the *Arabians*.

Arabesque, *Grotesque*, and *Moresque*, are Terms applied to such Paintings, Ornaments of Freezes, &c. on which there are no human or animal Figures; but which consist wholly of imaginary Foliages, Plants, Stalks, &c.

The Terms are deriv'd from the *Arabs*, *Moors*, and other *Mahometans*, who use these kinds of Ornaments, because their Religion forbids them to make any Images or Figures of Men, or other Animals.

ARÆOSTYLE

AR

ARÆOSTYLE [of ἀραιός, thin set, and εἶλος, *Gr.* a Column] a Term used by *Vitruvius*, to signify the greatest Interval or Distance which can be made between Columns; which consists of eight Modules, or four Diameters.

ARC, the same as *Arch*.

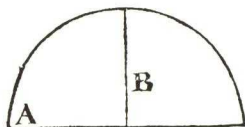
ARC-BOUTANT [of *arc* and *bouter*, *Fr.* to abut] is a flat Arch, or Part of an Arch abutting against the Reins of a Vault, to support and prevent its giving Way.

Arches-Boutants are only *Arch-Buttresses*.

ARCH [of *Arcus*, *L.*] is a Part of any Curve Line, *e. gr.* as of a Circle, an Ellipsis, and the like.

ARCH of a Circle, is a Part of the Circumference of it, less than half a Semicircle.

The Base or Line that joins the two Extremes of the *Arch*, is called the *Chord*; and the Per-



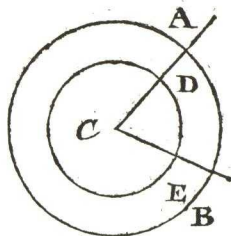
pendicular raised in the Middle of that Line, is the Sine of the *Arch*, as A and B in the Figure.

Every Circle is supposed to be divided into 360 Degrees, and an *Arch* is estimated according to the Number of these Degrees it takes up:—Thus an *Arch* is said to be 20, 30, 50, 80, 100 Degrees.

Equal ARCHES are such *Arches* of the same or equal Circles, as contain the same Number of Degrees.

AR

Similar ARCHES are such as contain the same Number of Degrees of unequal Circles, as the Figures annexed; which though



they are of Circles of different Magnitudes, yet are similar, both containing the same Number of Degrees, as suppose 45.

ARCH [in Architecture] is a concave Building, rais'd with a Mould bent in the Form of the Arch of a Curve, and serving as an inward Support of any Structure.

Sir *Henry Wotton* says, an *Arch* is nothing but a narrow contracted Vault; and a Vault adilated *Arch*.

Arches are used in large Inter-columniations of spacious Edifices; in Porticoes, both within and without Temples; in publick Halls, as Ceilings; the Courts of Palaces, Cloisters, Theatres, and Anti-Theatres.

Arches are also used as *Buttresses* and *Counter-Forts*, to support large Walls, and deep in the Earth; for Foundations of Bridges and Aqueducts; for Triumphal *Arches*, Gates, Windows, &c.

Arches are either *circular*, *elliptical*, or *straight*.

Circular Arches are of the three Kinds; *semicircular*, *scheme* or *sheen*; or of the third and fourth Point

Point, as some Workmen call them; though the *Italians* call them *Di Terzo* and *Quarto Acuto*, because they always meet in an acute Angle at the Top.

Semicircular Arches, are those *Arches* which are an exact Semicircle; and have their Centre in the Middle of the Diameter, (or Chord of the *Arch*,) or the Right Line that may be drawn betwixt the Feet of the *Arch*.

Of this Form the *Churches* of Bridges, Windows of Churches, and great Gates, are sometimes made in modern Buildings.

Scheme or *Skeen Arches*, are those which are less than a Semicircle, and consequently are flatter *Arches*, containing some 90, some 70, and others 60 Degrees.

Semicircular are easily distinguish'd from *Scheme Arches* by this; That the *Chord* (or Right Line) drawn between the Feet of a *Semicircular Arch*, is just double to its Height, (being measur'd from the Middle of the *Chord* to the Key-Piece or Top of the *Arch*;) whereas the *Chord* of a *Scheme Arch* of 96 Degrees will be more than four Times its Height, and the *Chord* of a *Scheme Arch* of 60 Degrees will be more than six Times its Height.

The famous *Alberti*, in his *Architettura*, says as follows: In all Openings in which we make *Arches*, we ought to contrive to have the *Arch* never less than a Semicircle, with an Addition of the seventh Part of half its Diameter; the most experienced Workmen having found that *Arch* to be by much the best adapted for enduring, in a Manner to Perpetuity; all other *Arches* being

thought less strong for supporting the Weight, and more liable to Ruin.

It is also thought that the half Circle is the only *Arch* that has no Occasion either for Chain, or any other Fortification; whereas all others are found either to burst out, or fall to ruin by their own Weight, if they are not either chain'd, or some Weight be placed against them for a Counterpoise.

I will not here omit, (says he) what I have observed among the *Antients*, a Contrivance certainly very excellent and praise-worthy: Their best Architects placed these Apertures, and the *Arches* of the Roofs of Temples, in such a Manner, that even though you took away every Column from under them, yet they would still stand firm, and not fall down, the *Arches* on which the Roof was placed, being drawn quite down to the Foundation with wonderful Art, known but to a few: So that the Work upheld itself by being only set upon *Arches*; for those *Arches* having the solid Earth for their Chain, no wonder they stood firm without any Support.

Arches of the third and fourth Point. These consist of two *Arches* of a Circle meeting in an Angle at the Top, and are drawn from the Division of a Chord into three, or four, or more Parts, at Pleasure.

Of this Kind are many of the *Arches* in old *Gothic* Buildings; but on account both of their Weakness, and Unsightliness, they ought, in the Opinion of Sir Henry Wootton, to be for ever excluded out of all Building.

Elliptical Arches. These *Arches* consist of a Semi-Ellipsis, and were formerly much used instead of Mantle-Trees in Chimneys. They are commonly described on three Centers; but they may be drawn otherwise: These consist of three Parts, *viz.* two *Hanches*, and a *Scheme*. Each End of these *Arches* are called *Hanches* by Workmen; and these *Hanches* are always the *Arches* of Circles, smaller than the *Scheme*, which is the middle Part of these *Arches*, and consists of a Part of a larger Circle, which is drawn betwixt the two *Hanches*, to conjoin them all together, in order to make, as it were, one *Heliacal Line*, and consequently an *Elliptical Arch*.

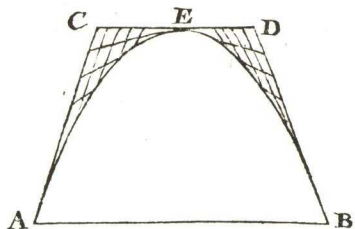
To these *Arches* there are commonly a *Key-Stone* and *Chaptrrels*: The *Key-Stone* is that which is the very Summity or Top of the *Arch*, and is equally distant from both Ends; and the Breadth of this *Key-Stone* at the Top ought to be equal to the Height of the *Arch* (which is usually about fourteen Inches, when made of Brick;) and *Summer*, (or Point with two Edges, to the Centre of the *Scheme*.) The *Key-Stone* ought to be so much without the *Arch*, as the *Chaptrrels* project over the *Jaumbs*.

The *Chaptrrels*, I suppose to be the same that most Architects call *Imposts*; and 'tis those on which the Feet of the *Arches* stand, the Height or Thickness of which ought to be equal to the Breadth of the lower Part of the *Key-Stone*.

N. B. That each other Course in these *Arches* consists of two *Stretchers*, which are seven Inches long each, (when the *Arch* is fourteen Inches deep,) and the other Courses betwixt these of three *Headers*, and two *Closers*; the Length of the *Headers* ought to be three Inches and a half, and the *Closers* one Inch and three quarters: Thus one Course of the *Arch* will be divided into two *Stretchers*; and the other alternately into three *Headers*, and two *Closers*, throughout the whole *Arch*.

How to describe an *Elliptical Arch* to any Rise or Width, by the Intersection of Right Lines.

First, Draw the Line *A B*, then draw *B C* perpendicular to *A B*,

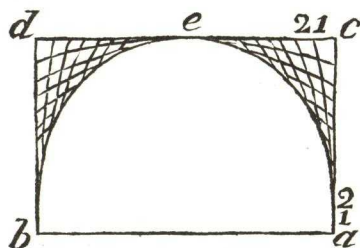


and as high as you design the *Arch* shall rise, and draw the Line *C D* parallel to *A B*, which divide into two equal Parts at *E*; then divide *AC* and *BD* into any Number of equal Parts; also *CE* and *ED* into the same Number of equal Parts, and draw Right Lines to each correspondent Division, as from 1 to 1, from 2 to 2, and so on; and then will the Intersections of those Lines create the *Arch* *A E B*.

A R

A R

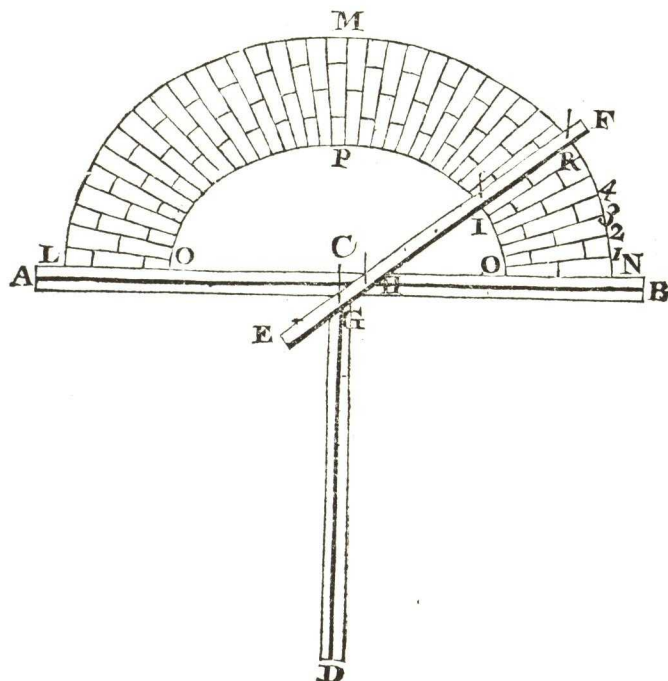
How to draw an *Elliptical Arch* reverse.



First, Draw the Base Line AB, then draw the Line CD parallel

and equal to the Line AB, and so far distant as you design the Arch shall rise, and draw the Lines CA and DB; then divide CA and DB into any Number of equal Parts, also CE and ED into the same Number of equal Parts, and draw Right Lines to each correspondent Division, as from 1 to 1, from 2 to 2, and so on, till you have described the Arch AEB; which was to be done.

To strike and find the Moulds of an *Elliptical Arch*, either in Brick or Stone.



First, Place the Trammel ABCD, (on which is a Groove, as AB and CD;) then propose the

Widths OQ, OL, and QN, prepare a straight Lath EF, somewhat longer than half the Base
C 2 CL

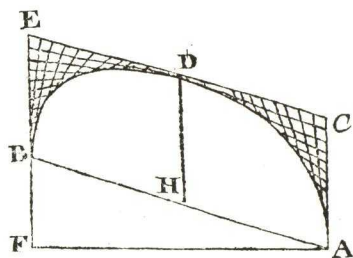
CL or CN; then put in a Pencil or Marker at K; also at I; so that IK is equal to QN, or OL, or PM; then put in a Wooden Pin at H and G, letting IH be equal to CP, also GK to CN; then fix one Hand at K, and the other at G, and keep the two Pins G and H in the Grooves AB and CD, and turn about the Lath FE; then will the Markers mark'd I and K, create the two *Arches* LMN and OPQ.

To give the *Bricks* or *Stones* the true Summering, divide the *Arch* LMN into so many equal Parts as the Thickness of the Brick will allow, as 1, 2, 3, 4, &c.

Bring down the Sliding-Lath to 1, and on its Edge draw the Summering or Joint of the first Brick, then move it to 2; in the same Manner draw the Summering of the next Brick, and so on. The Cross-Joints are drawn by the same Rule, as the *Arches* LMN or OPQ.

To draw the *Elliptical Arch* ramping.

First, Draw the Level Line AF, and divide it in the Middle



at G; then erect a Perpendicular at Pleasure from F to E, also from A towards D, and from A towards C; then draw the Raking Line AB, and set up the Height of the *Arch* from A to C,

and from B to E, and draw the Line CE; then divide the Lines AC and CD into any Number of equal Parts; also the Lines BE and ED, and draw the Right Lines, as in the foregoing Examples, which will create the *Arch* ADB.

Straight ARCHES are those whose upper and under Edges are straight; whereas in the others, they are curved; and those two Edges also parallel, and the Ends and Joints all pointing towards one certain Centre. These are principally used over Windows, Doors, &c.

And it is a general Rule among Workmen, that according to the Breadth of the Peers between the Windows, so ought the Skew-back or Summering of the Arch to be; for if the *Peers* be of a good Breadth, as suppose three or four Bricks in Length, then the *Straight Arch* may be described from the *Oxi*, (as it is vulgarly called by Workmen,) being a Contraction of the Word *Oxygonium*, which is the Name of an Equilateral Triangle: But if the Peers are small, as they are sometimes, being but of the Length of two Bricks, and sometimes again, but of one Brick and a Half, then the Breadth of the Window, or more, may be the Perpendicular (to the Middle of the Underside of the *Arch*,) at the End of which below, shall be the Centre for the *Skew-back* or *Summering* to point to.

These *Straight Arches* are usually about a Brick and half, which when rubb'd, makes about twelve Inches high, although sometimes they are but eleven

eleven Inches, or thereabouts, which answers to four Courses of Bricks; but notwithstanding, they may be made either more or less in Height, according as Occasion requires.

N. B. By the Term *Skew-back*, is to be understood the Levelling-End of the *Arch*; and by *Summering*, the Level-Joints betwixt the Courses of Bricks in an *Arch*. These *Arches* usually consist of a *Stretcher* and a *Header* in Height; the *Stretchers* being a whole Brick's Length, and the *Headers*, a Brick's Breadth.

The Doctrine and Use of *Arches* is well delivered by Sir Henry Wotton, in the five following *Theorems*.

Theorem I. All Matter, unless impeded, tends to the Centre of the Earth in a perpendicular Line, or descends perpendicularly downwards; because Ponderosity is a natural Inclination to the Centre of the Earth, and Nature performs her Motions by the shortest Lines.

Theorem II. All solid Materials, as Bricks, Stones, &c. moulded in their ordinary Rectangular Form, if laid in Numbers, one by the Side of another, in a level Row, and their extrem Ends sustained between two Supporters, all the Pieces between will necessarily sink even by their own natural Gravity; and must much more, if they are pressed down, or suffer any Pressure by a super-incumbent Weight; because their Sides being parallel, they have Room to descend perpendicularly without Impediment, according to the former *Theorem*; therefore to make them stand, either their

Figure or their Position must be altered.

Theorem III. Stones, Bricks, or other Materials, being figured *cuneatim*, i. e. wedge-wise, somewhat broader above than below, and laid in a level Row, with their two Extrems supported, as in the preceding *Theorem*, and pointing all to the same Centre; none of the Pieces between can sink, till the Supporters or Butments give way, because they want Room in that Situation, to descend perpendicularly.

But this is but a weak Structure; because the Supporters are subject to too much Impulsion, especially where the Line is long: For which Reason, this Form of *Straight Arches* is seldom used; but over Doors and Windows, where the Line is short. — Therefore, in order to fortify the Work, the Figure of the Materials must not only be changed, but the Position of them too; as will appear in the following *Theorem*.

Theorem IV. If the Materials be shap'd wedge-wise, and disposed in the Form of a circular *Arch*, and pointing to some Centre: In this Case, neither the Pieces of the said Arch can sink downwards for want of Room to descend perpendicularly, nor can the Supporters or Butments of this Arch suffer so much Violence, as in the preceding flat Form; for the Roundness, or rather Convexity, will always make the incumbent Weight rather rest upon the Supporters, than heave or shove them outwards; whence this Corollary may be fairly deduced, That the safest or most se-

cure of all the Arches above mention'd, is the Semicircular; and of all Vaults; the Hemispherical, although not absolutely exempted from some natural Imbecility, (which is the sole Prerogative of Perpendicular Lines and Right Angles,) as has been observ'd by *Bernardino Baldi*, Abbot of *Guaftalla*, in his Commentary upon *Aristotle's Mechanics*; where, by the way, it is to be noted, that when any Thing is demonstrated mathematically to be weak, it is much more so mechanically; Errors always occurring more easily in the Management of gross Materials, than in Lineal Designs.

Theorum V. As Semicircular Arches, or Hemispherical Vaults, rais'd on the whole Diameter, are the strongest and securest by the precedent Theorem, so they are also the most beautiful; which keeping precisely to the same Height, are yet distended one Fourteenth Part longer than the said Diameter; which Addition of Width will contribute greatly to their Beauty, without diminishing any Thing considerable of their Strength.

However, it is to be observ'd, that according to Geometrical Strictness, in order to have the strongest *Arches*, they must not be Portions of Circles, but of another Curve, called the *Catenaria*; the Nature of which is such, that a Number of Spheres disposed in this Form, will sustain each other, and form an *Arch*. See *Catenaria*.

Dr. Gregory, Philosoph. Transactions, N^o 231. has shewn, that *Arches* constructed in other Curves, only stand or sustain

themselves by Virtue of the *Catenaria* contain'd in their Thickness; so that if they were made infinitely slender or thin, they must of course tumble; whereas the *Catenaria*, though infinitely slender, must stand by reason that no one Point of it tends downwards more than any other. Vide *Vault*.

Of Measuring Arches. Whether the *Arches* be straight or circular, they must be measured in the Middle, *i. e.* if a *Straight Arch* be ten Inches in Height or Depth, the Length must be measured in the Middle of the ten Inches; which Length will not be any longer, than if it were measured at the Under-side next to the Head of the Window, by so much as one Side of the *Springing Arch* is skew'd-back from the Upright of the Jaumbs, Peers, or Coins of the Windows.

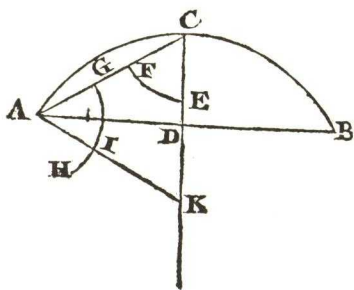
And also in *Circular Arches*, it is to be observed, that the upper Part of the *Arch* is longer (if girt about) than the under Part, by reason that it is the Segment of a greater Circle, cut off by the same Right Line that the lesser is, and for that Reason must be girt in the Middle.

As to the Price. As for the Workmanship of *Straight Arches*, (of Brick,) handsomely set, and well rubb'd, in *London*, about eight Pence or nine Pence a Foot; but if the Workman finds Materials, he will have ten Pence, or one Shilling per Foot. But in some Parts of *Suffex* and *Kent*, they will require one Shilling per Foot; nor will they do it under running Measure.

Scheme or *Sbeen* Arches, and *Elliptical* ones of *rubb'd Brick*, are usually much about the same Price as *Straight Arches*. But if the *Scheme Arches* are of *unrubb'd Bricks*, they are usually included in the Plain Work, unless the Plain Work be done at a low Price: But you must take notice, that the Owner or Master of the Building must be at the Charge of the Centres to turn the *Arches* on, and not the Workman, unless an Allowance be made him for it in the Price of the Work.

How to describe a *Scheme Arch*, when the Base and Perpendicular are given.

First, Draw the Line AB,

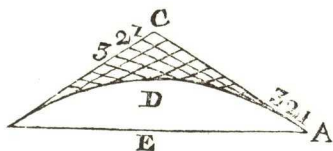


with it, through the Middle D, at Pleasure, and set up the Height you desire to rise from D to C, and draw the Line CA; then open your Compasses to any convenient Distance, set one Foot in C, and strike the Arch FE; with the same Opening of the Compasses, set one Foot in A, and strike the Arch from G to H, at Pleasure; then take the Radius EF in your Compasses, and set it on the Arch GH, as at I, and

draw a Right Line from A through I, to cut the Perpendicular, as at K; then is K the Centre to strike the Arch ACB. Which was to be done.

The Base and Perpendicular of a *Scheme Arch* being given, how to describe it by an Intersection of Lines.

First, Draw the Base AB, and Middle at E, from whence set



up perpendicularly to C, twice as much as you would have the Arch to rise, and draw the Lines CB and CA, and divide each Line into any Number of equal Parts, and draw Right Lines to every correspondent Division, as from 1 to 1, from 2 to 2, from 3 to 3, and so on; and then will the Intersections of those Lines create the Arch ADB. Which was to be done.

It is the ordinary Proportion of *Arches*, that the Height be made double the Width; but this may be varied, and made a little more, or a little less, as Occasion requires. *Le Clerc.*

When *Arches* are to be at some Distance from each other, for the Convenience of any Apartments, either above or underneath, the Columns which separate them ought to be in Couples; but when they are in Couples, they should have but one Pedestal, if they have any Pedestal at all.

Arch is particularly used for the Space between the two Peers of a Bridge. The Chief or Master *Arch*, is that in the Middle, which is the widest, and commonly highest, and the Water that runs under it the deepest, being design'd for the Passage of Boats, or other Vessels. Some Relations mention Bridges in the *East* having 300 *Arches*. See *Bridge*.

A *Triumphal Arch* is a Gate or Passage into a City, magnificently adorn'd with Architecture, Sculpture, Inscriptions, &c. which being erected either of Stone or Marble, are used not only as Decorations in Triumphs, on account of some Victory, but also to transmit the Memory of the Conqueror to Posterity.

The most celebrated *Triumphal Arches*, that are now remaining, are those of *Titus*, of *Sep-*

timus Severus, and of *Constantine* at *Rome*.

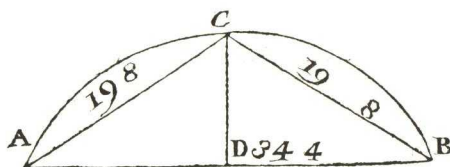
To find the Length of an *Arch Line* geometrically;

Divide the Chord Line A B into four equal Parts, and set one



of those Parts from B to C, and draw a Line from C to three of those Parts at D; so shall CD be equal to half the *Arch-Line* A C B.

To find the Length of an *Arch-Line* Arithmetically; Multiply the Chord or half the Segment A C or C B by 8, and from the Product subtract the Chord of the whole Segment A B, and divide the Remainder by 3, the Quotient will be the *Arch-Line* A C B sought.



$$\begin{array}{r} 19.8 \text{ A C.} \\ 8 \end{array}$$

$$\begin{array}{r} 158.4 \\ 34.4 \text{ A B.} \\ \hline \end{array}$$

$$\begin{array}{r} 124 \\ \text{Arch-Line 41. 333} \end{array}$$

Another Way.

From the double Chord of half the Segment's *Arch* subtract the Chord of the Segment, one

third Part of the Difference added to the double Chord of half the Segment's *Arch*, the Sum is the

the Arch Line of the whole Segment. Thus, if AC 19. 8 be doubled, it makes 39. 6; from which, if you subtract 34. 4, the Remainder is 52; which divided by 3, the Quotient is 1. 733: This being added to 39. 6, (the double Chord of the Half Segment,) the Sum will be 41. 333. So if the Arch-Line ACB were stretch'd out strait, it would then contain 41. 333 such Parts as the Chord AB contains, 34. 4 of the like Parts.

ARCHITECT [*Αρχιτεκτων*, of *αρχος* Chief, and *τεκτων* an Artificer or Builder, *Gr.*] a Matter Workman in a Building, he who designs the Model, or draws the Plot, Plan, or Draught of the whole Fabrick; whose Business it is to consider the whole Manner and Method of the Building; and also to compute the Charge and Expence. In the managing of which, he ought to have regard to its due *Situation*, *Contrivance*, *Receipt*, *Strength*, *Beauty*, *Form*, and *Materials*.

The Name *Architect* is also used for the *Surveyor*, or *Superintendent* of an Edifice, the Management being wholly committed to his Circumspection; wherefore he ought to manage the whole Affair prudently and advisedly, with the utmost Caution, that all Matters may be ordered and disposed, (in all Circumstances,) so as to answer the Owner's Design, and be consistent to Reason.

But notwithstanding the Care of the whole Fabrick be incumbent on this *Surveyor*, or *Superintendent*, yet Sir Henry Wotton advises the having a second *Superintendent*, (or *Officiator*, as he is

called by *Vitruvius*,) whose Business is to chuse, (or examine,) and sort all the Materials for every particular Part of the Building.

Vitruvius enumerates 12 Qualifications requisite for a complete *Architect*; that he be docile and ingenious, literate, skill'd in Designing, in Geometry, Opticks, Arithmetick, History, Philosophy, Musick, Medicine, Law, and Astrology.

The most celebrated ancient *Architects* are *Vitruvius*, *Palladio*, *Scamozzi*, *Serlio*, *Vignola*, *Barbaro*, *Cataneo*, *Alberti*, *Vida*, *Bullant*. *De Lorme*, and many others.

ARCHITECTONICK, that which builds a Thing up regularly, according to the Nature and Intentions of it. The Term is usually apply'd to that plastick Power, *Spirit*, or whatever else it be, which hatches the Ova of Females into living Creatures, which is called the *Architectonick Spirit*; yet it is also apply'd to the chief Overseer of Buildings, or an Architect.

ARCHITECTURE, the Art of Building, or a Mathematical Science, which teaches the Art of erecting *Edifices proper either for Habitations or Defence*; being a Skill obtain'd by the Precepts of *Geometry*; by which it gives the Rules for designing and raising all sorts of Structures, according to the Rules of *Geometry* and *Proportion*, and contains under it all those Arts which conduce any Thing to the framing Houses, Temples, &c.

The Scheme or *Projection* of a Building is usually laid down in three several Designs or Draughts.

The

The *first* is a *Plan*, which exhibits the Extent, Division, and Distribution of the Ground into Apartments and other Conveniences.

The *second* shews the Stories, their Heights, and the outward Appearances of the whole Building: And this is usually called the *Design* or *Elevation*.

The *third* is commonly called the *Section*, and shews the Inside of the Fabrick.

From these three Designs, the Undertaker frames a Computation of the Charges of the whole Building, and the Time requisite to complete it.

As to the *Antiquity* of *Architecture*: *Architecture* is scarce inferior, in Point of Antiquity, to any other Arts. Nature and Necessity taught the first Inhabitants of the Earth to build or set up Huts, Tents, and Cottages; from which, in Process of Time, they gradually advanced to raising more regular and stately Dwellings, set off with Variety of Ornaments, Proportions, &c.

Antient Writers ascribe the carrying of *Architecture* to a tolerable Height to the *Tyrians*, who were therefore sent for by *Solomon* for the Building of his Temple.

But *Villapandus* will not allow those who were sent for from *Tyre* to be any more than under Workmen, such as Artificers in Gold, Silver, Brass, &c. and supposes that the Rules of *Architecture* were delivered by God himself to *Solomon*.

So that the *Tyrians* rather learnt *Architecture* from *Solomon*, than he from them; which they afterwards communicated to the *E-*

gyptians, and these to the *Greeks*, and the *Greeks* to the *Romans*.

He undertakes to prove, that all the Beauty and Advantages of the *Greek* and *Roman* Fabricks were borrowed from *Solomon's* Temple.

Sturmius produces several Passages in *Vitruvius* in Confirmation of this, where the Rules laid down in his *Lib. VI. cap. 11.* and *Lib. V. cap. 1.* square exactly with what *Josephus* relates of the *Jewish* Temple, in his Sixth Book.

But the 23d Chapter of *Isaiah*, Ver. 8. informs us to what a Pitch of Magnificence the *Tyrians* and *Egyptians* had carried *Architecture* before it came to the *Greeks*; and *Vitruvius* also gives an Account of the *Egyptian* *Oecus*, their *Pyramids*, *Obelisks*, &c.

Yet, in the common Account, *Architecture* seems to be wholly of *Greek* Original. Three of the regular Orders or Manners take their Names from the *Greeks*, as *Corinthian*, *Ionian*, and *Doric*; and we have scarce a Part, a single Member, or Moulding, but what comes to us with a *Greek* Name.

And it is certain the *Romans*, from whom we take it, borrowed all they had entirely from the *Greeks*; nor do they seem to have had before any other Notion of the Grandeur and Beauty of large Buildings, but what arises from Magnitude, Strength, &c.

Architecture is accounted to have arrived at its Glory in the Time of *Augustus* *Cesar*; but both that, and other polite Arts, were neglected under *Tiberius*.

Nero, indeed, notwithstanding his many Vices, retain'd an uncommon

common Passion for *Architecture*; but Luxury and Dissoluteness had a greater Share in it, than true Magnificence. In the Time of *Trajan*, *Apollodorus* excell'd in the Art; by which he merited the Favour of that Prince, and erected that famous Column called *Trajan's*, which is remaining to this Day.

But after his Time *Architecture* began to decline; though it was for some Time supported by the Care and Magnificence of *Alexander Severus*, yet it fell with the Western Empire, and sunk into Corruption; from whence it was not recovered for the space of 1200 Years.

All the most beautiful Monuments of Antiquity were destroyed by the Ravages of the *Visigoths*; and from that Time *Architecture* became so coarse and artless, that their professed Architects knew nothing at all of just Designing, wherein the whole Beauty of *Architecture* consists: Hence a new Manner of *Architecture*, called *Gothic*, took its Rise.

Charlemagne set himself industriously about the Restoration of *Architecture*; and the *French* applied themselves to it with Success, under the Encouragement of *Hugh Capet*. His Son *Robert* prosecuting the same Design, the modern *Architecture*, by Degrees, ran into as great an Excess of Delicacy, as the *Gothic* had before done of Massiveness.

We may add to these the *Arabesk*, *Moresk*, or *Moorish Architecture*, which were much of the same Kind with the *Gothic*; except, that as the former was brought from the North by the

Goths and *Vandals*, the latter was brought from the South by the *Moors* and *Saracens*.

The Architects of the 13th, 14th, and 15th Centuries, who had some Knowledge of Sculpture, seem'd to make Perfection consist altogether in the Delicacy and Multitude of Ornaments, which they bestow'd on their Buildings with abundance of Care; but often without Conduct or Taste.

In the two last Centuries, the Architects of *Italy* and *France* were industriously bent upon retrieving the primitive Simplicity and Beauty of antient *Architecture*; nor did they fail of Success: Inasmuch, that now our Churches, Palaces, &c. are wholly built after the *Antique*.

Civil Architecture may be distinguished, with respect to the several Periods or States of it, into *Antique*, *Antient*, *Gothic*, *Modern*, &c.

Another Division of *Civil Architecture* arises from the different Proportions, which the different Kinds of Buildings rendered necessary, that there might be some proper for every Purpose, according to the Bulk, Strength, Delicacy, Richness, or Simplicity required.

From hence proceeded the five Orders or Manners of Building, all invented by the Antients, at different Times, and on different Occasions, viz. *Tuscan*, *Doric*, *Ionic*, *Corinthian*, and *Composite*.

That which forms an Order, is the Column, with its Base and Capital, surmounted by an Entablature consisting of Architrave, Freeze, and Cornice, sustain'd by a *Pedestal*.

We have no *Greek* Authors now extant on Architecture: The first who wrote was *Agathereus* the *Athenian*. He was seconded by *Democritus* and *Theophrastus*.

Of all the Antients, *Vitruvius* is the only Author we have entire, notwithstanding that he relates that there was 700 Architects in *Rome* in his Time.

Vitruvius, in the Time of *Augustus*, wrote a compleat System of Architecture in ten Books, which he dedicated to that Prince.

The Moderns censure two Things in this excellent Work, viz. want of Method, and Obscurity.

The Mixture of *Latin* and *Greek* in *Vitruvius* is such, that *Leon. Baptist. Alberti* has observed, that he wrote *Latin* to the *Greeks*, and *Greek* to the *Latins*: He also says, that there are abundance of Things superfluous and foreign to the Purpose contain'd in that Work.

For this Reason, *M. Perrault* has extract'd all the Rules out of the prolix Work of *Vitruvius*, methodiz'd and publish'd them in a small Abridgment.

Several Authors have attempted to explain the Text of *Vitruvius*, as particularly *Philander*, *Barbaro*, and *Salmasius*, in Notes added to their several Editions in *Latin*; *Rivius* and *Perrault*, in the Notes to their *German* and *French* Versions; and *Baldus*, in his *Lexicon Vitruvianus*.

M. Perrault also has compos'd an excellent Treatise of the five Orders, which may be look'd

upon as a Supplement to *Vitruvius*, he having left the Doctrine of the Orders imperfect.

The Authors who have written on Architecture since *Vitruvius*, are *Leon. Baptist. Alberti*, who published in *Latin* ten Books of the Art of Building, designing to outvie *Vitruvius*; but however has not succeeded in his Design, although his Books contain a great Number of good Things, but is deficient in the Doctrine of the Orders.

Sebast. Serlio also wrote seven Books of Architecture, five of which were concerning the Five Orders, were published in 1602: through the Whole of which he strictly keeps to *Vitruvius's* Rule; the seventh was published afterwards in the Year 1675.

Philip de Lorme published nine Books of Architecture in *French*, in the Year 1667.

J. Barozzio de Vignola published his Rules of the Five Orders in *Italian*, in the Year 1631; which have been since translated, with large Additions by *Daviler*, under the Title of *Cours d'Architecture*.

Also *Vincent Scamozzi's* Idea of *Universal Architecture* was publish'd in *Italian*, in the Year 1615; and *Car. Phil. Diensart's* *T'caire of Civil Architecture* was published in *High Dutch* in the Year 1697; in which he not only delivers the Rules of *Architecture*, but also explains and compares the Five Orders, as laid down by *Palladio*, *Vignola*, *Scamozzi*, &c.

R. Freart de Cambray also pursued the same Design in *French*, in a Parallel of the Antient Architecture with the Modern; which

which was published in 1650, and translated into *English* by Mr. *Evelyn*, with Additions.

Fr. Blondel, Director of the Royal Academy of Painting, &c. in 1698, gave a *Course of Architecture* in *French*, which was a Collection from all the celebrated Writers upon the Subject of the Orders, &c.

Nich. Goldman has also done good Service, by reducing the Rules and Orders of *Architecture* to a farther Degree of Perfection, and shewing how they may be easily delineated, by Means of certain Instruments invented by him. This Treatise was published in *Latin* and *High Dutch*, in the Year 1661.

Also Sir *Henry Wotton* has laid down the *Elements of Architecture*, which have been reduced by *Sturmius* and *Wolfius* to certain Rules and Demonstrations. And by these Gradations has *Architecture* been brought to a Mathematical Art; by the first in his *Mathesis Juvenilis*; and by the second, in his *Elementa Mathematicos*, Tom. II. Anno 1715.

Military Architecture is the Art of strengthening and fortifying Places, to screen and defend them from the Insults of Enemies, and the Violence of Arms. This is more commonly called Fortification, and consists in the erecting Forts, Castles, Fortresses, with Ramparts, Bastions, &c.

Naval Architecture is the Art of Building, or that which teaches the Construction of Ships, Gallies, and other floating Vessels for the Water; also Ports, Moles, Docks, &c. on the Shore.

Architecture in Perspective, is a Sort of Building, wherein the

Members are of different Measure and Modules, and diminish proportionably to their Distance, in order to make the Work appear longer and larger to the View, than really it is.

Of this Kind is the celebrated Pontifical Staircase of the *Vatican*, built in the Time of Pope *Alexander VII.* by the Cavalier *Bernini*.

Counterfeit Architecture, is that which consists of Projectures, painted either in Black or White, or Colours after the Manner of Marble; as is to be seen perform'd in the Facades and Palaces in *Italy*, and in the Pavillons of *Marli*.

This Painting is done in Fresco upon plaistered Walls, and in Oil on stone Walls.

Also, under the Title of *Counterfeit Architecture*, is to be comprehended, that which may be also called *Scene Work*, i. e. that painted on slight Boards, or wooden Planks, on which Columns, Pilasters, and other Parts of Building, seem to stand out with a *Relievo*; the Whole being coloured in Imitation of various Marbles, Metal, &c. serving for the Decorations of Theatres, Triumphal Arches, &c.

ARCHITRAVE [of ἀρχιτράβη chief, and trabes, L. a Beam] is that Part of a Column, or Order of Columns, which lies immediately upon the Capital; the *Architrave* is the lowest Member of the Frize, and even of the whole Entablature.

The *Architrave* is supposed to represent the principal Beam in Timber Buildings; from whence it takes its Name, as above.

But to this it is objected by some, that they do not well understand what is meant by the principal Beam of a Building; because they do not suppose that it can properly be applied to all Buildings, but only to some peculiar Kinds, such as are called *Portico's*, *Piazza's* or *Cloisters*, (by which are usually understood long Kinds of Galleries, or Walking Places, whose Roofs are borne or supported by Columns or Pillars, at least on one Side, which have not Arches arising from them, to support the super-incumbent Part of the Fabrick,) but have a Beam resting or lying upon the Tops of the Columns, by which the superior Part of the Edifice is supported; upon which Account, it is probable, it is called the principal Beam.

'Tis true, according as Mr. *Perrault* defines it, it is the first Member of the *Entablement*, being that which bears upon the Column, and is made sometimes of a single *Summer*, as appears in the most antient Buildings; and sometimes of several Haunches, as is usually seen in the Works of the Moderns.

Architrave is also sometimes called the *Reason-Piece*, or *Masler-Beam*, in Timber Buildings; as *Portico's*, *Cloisters*, &c. In Chimneys it is called the *Mantle-Piece*; and over Jaumbs of Doors, and Lintels of Windows, *Hyperthyron*.

Architrave Doors, are those which have an Architrave on the Jaumbs, and over the Door, upon the Cap-Piece, if straight, or on the Arch, if the Top be curv'd.

Architrave Windows, of Timber, are commonly an Ogee, raised out of the solid Timber, with a Lint over it; though sometimes the Mouldings are struck, and laid on, and sometimes are cut in Brick.

The upper *Fatio* is called the *Header*, or Heading *Architrave*.

Architects take a deal of Latitude as to *Architraves*, some using more Members than others, and many of them having two or three Forms of *Architraves*.

Sometimes they are according to one of the Five Orders of Architecture; but at others, they are according to the Fancy of the Workman.

As some, for an *Architrave* round a Door, have put first a small Bead next the Door, then a broad Plinth, or *Fatio*, and above that an Ogee and Lint.

There are *Architraves* of Stone and Brick, as well as of Timber.

Brick Architraves are usually cut in the Length of a Brick, and sometimes in the Length of a Brick and half, and then every other Course alternately consists of the Breadth of two Bricks; the upper one, on which the Ogee is cut, and Part of the upper *Fatio*, they call *Header*, or *Heading Architrave*; and the Breadth or Head of Bricks, on which the lower *Fatio*, and Part of the upper one is cut, they call a *Jak Architrave* of Stone.

The Kinds: *Architraves* are distinguished into five Kinds, viz.
Tuscan,

Tuscan, Doric, Ionic, Corinthian, and *Composite*, according to the five Orders of Columns.

Of the Parts, or Members: These are more numerous than the Kinds, because there are two different Sorts of *Architraves* to some of the Orders; and that which yet more increases the Number is, that some Authors differ from others in the Form of the same Orders.

The *Tuscan Architrave*, according to *Vitruvius*, ought to be half a *Mode*, or *M.* in Height. This general Member he has described in two Forms: The first consists of three Parts or Members, *viz.* two *Fatio's* and a *Cymatium*, and is thus divided: The whole Height is divided into six Parts; which are divided after this Manner, *viz.* the uppermost sixth Part is the *Cymatium*; which being subdivided into three, the upper Part is to be the *Fillet*, and the two lower Parts the *Ogee*.

The five grand Divisions which remain, are to be divided into nine Parts, five of which are to be the upper *Fatio*, and the other four the lower one.

His second Form is as follows, consisting of but three Members, or Parts, *viz.* a large *Plinth* or *Planchier*, a *Casement*, and a large *Fillet*, and is subdivided as follows: The whole Height is divided into six; and the upper Part is for the *Fillet*, (which projects in Square beyond the *Plinth*;) the fifth Part is for the *Casement*, (which rises from the Plain of the *Plinth*, and ends in a Quadrant as the lower Corner of the *Fillet*;) the other four

Parts remaining are for the *Plinth*, or *Planchier*, or *Fatio*.

Palladio has also two distinct Forms for the *Tuscan Architrave*: The first consists of two *Fatio's* and a *List*: The lower *Fatio* is twelve and a half *M.* high, the upper *Fatio* is seventeen and a half *M.* ending with a quadrantal *Casement* rising with its Plain, and ending with the lowest Corner of the *List*; the *List* is five *M.* high; and so the whole Height of the *Architrave* is thirty-five *M.*

His second *Architrave* is only a plain *Fatio* of thirty-five *M.* high.

Scamozzi, according to his Delineations, makes the *Tuscan Architrave* thirty-one and a half *M.* high, which he divides into four Parts, or Members, *viz.* two *Fatio's*, a *List* and a *Plinth*. He makes his first *Fatio* ten *M.* his second sixteen and a half *M.* his *List* one and a half *M.* and his *Plinth* three and a half *M.* all which make Thirty-one and one Third *M.* Though, according to this verbal Account, he says, it must be thirty-two and a half *M.* except it be a typographical Error.

Vignola describes the *Architrave* with the same Parts, Height, and Form with *Vitruvius's* second.

The *Doric*. This *Architrave*, according to *Vitruvius*, is half a *M.* in Altitude, which he delineates in two Forms: The first he divides into seven Parts; the uppermost of which is the *Tenia*, the other six Parts which remain he makes a *Fascia* under the *Tenia*,
and

and places Drops, whose Height are one Seventh of the Architrave: A Fourth of this Seventh is the *Fillet*, to which the *Drops* hang; the Drops are in Number six, placed under, and of the same Breadth with the *Triglyphs*.

His *Second Figure* of his *Architrave* consist of the same Members with the first, and the whole Height is equal to the first. But he divides the Altitude only into six Parts; the upper one of which, is his *Tenia*, and the other Five, the *Fascia*; the uppermost of which, is the Altitude of his Drops, which have a *List*, which is one Quarter of their Height.

Palladio makes this *Architrave* of the same Altitude with *Vitruvius*, but of a different Form; for he makes it to consist of three Parts or Members, viz. two *Fascia's* and *Tenia*: He divides the whole Altitude into six Parts, one of which being five M. he assigns for the *Gutta*, Drops, or Bells, and the *Listella* of the Drops is one Fifth of the whole Height, and one Third M. and the Drops Two and two Thirds M. The *Tenia* above the Drops (or rather of the *Architrave*,) he also makes Four and a half M. and the *Prima* (or Upper) *Fascia*, Fourteen one half M. and the *Secunda* (or Lower) eleven M. in all thirty M. which is the whole Altitude.

Scamozzi (according to the Portraiture of this *Architrave*) makes it thirty-five M. in Altitude; and he makes this grand Member to comprehend three petty Members, viz. two *Fascia's*, and a *List*; the Dimensions of which are, beginning at the

Top, and so descending; the *List* he makes five M. the upper *Fascia* eighteen M. and the lower one twelve M. in all thirty-five M. Divides the Drops or Bells thus: He designs the *List* above to be One one half M. and the Bells or Drops Four one half M. so that the whole Height is six M.

Vignola make this *Architrave* thirty M. in Altitude, the same as *Vitruvius* and *Palladio*; both which he also imitates in the lesser Member: For he has two distinct Forms; one like to that of *Vitruvius*, which contains two Members or Parts, the one a *List*, the other a *Fascia*; his other Form is like that of *Palladio*, comprehending three petty Members, viz. one *Tenia*, and two *Fatio's*.

The *Ionick*, according to *Vitruvius's* Order, this grand Member ought to be half an M. in Height. He describes two Forms of *Architraves* in the *Ionick* Order, viz. one for the *Ionick* Column, without a Pedestal; and the other, with a Pedestal.

He composes that without a Pedestal, of four minuter Parts, viz. three *Fascia's*, and a *Cymatium*; which is divided, as follows: He divides the whole Altitude into seven Parts, the uppermost of which he allots to the *Cymatium*, which he subdivides into three Parts; the uppermost of which, is for the *List*, and the two remaining for the *Ogee*.

The other six remaining Parts are divided into twelve; five of which he makes the upper *Fascia*, four the middle one, and three the lowest.

The other for the *Ionic* Column with a Pedestal, he proportions, as follows, *viz.* he reckons the whole Altitude of the *Architrave*, *Freeze*, and *Cornish*, to be two Mod. which are divided into ten Parts; three of which, are for the *Architrave*, (which is thirty-six M.) which he distinguishes into six minuter Parts, or Members; which he names as follows, (beginning at the Top, and so descending,) *viz.* a *Fillet*, a *Cima*, a *Thorus*, and three *Fascia's*; all which smaller Members he thus finds, *viz.*

First, he divides the whole Altitude into six equal Parts; the uppermost of which Parts he subdivides into four Parts: The highest of these four is for the *Fillet*, the two next of the four are allotted to the *Cima*, and the fourth, that remains, is for the *Thorus*.

The five grand Divisions which remain, are subdivided into twelve, which are distributed as follows, *viz.* five for the upper, four for the middle, and three for the lower *Fascia*.

Palladio assigns thirty-four M. for the Height of this *Architrave*. According to his Scheme of this Member, it is composed of seven Parts, *viz.* a *Lift*, a *Cima*, three *Fascia's*, and two *Astragals*; which are proportion'd as follows: To the *Lift* (which is above the *Cima*.) he allots two three Tenths M. to the *Cima*, four three Fifths M. to the upper *Fascia* he allows ten one Eighth M. to the *Astragal*, at its Foot, one third M. the middle *Fascia* is to contain seven fifty-two Sixtieths; and the *Astragal*

at its Foot one Third M. to the lower *Fascia* he assigns six nine Tenths M. All which being added together, amount to thirty-four one half M.

Scamozzi makes the *Ionic Architrave* thirty-five M. high, and of the same Form with that of the Second of *Vitruvius*, consisting of six Parts, *viz.* a *Lift*, *Cima*, *Astragal*, (or *Thorus*,) and three *Fascia's*; which he proportions, as follows: He allots two one half M. to the *Lift*, to the *Cima* four, to the *Thorus* two, to the upper *Fascia* eleven one half, to the middle one eight one half, and to the lower one six one half.

Signola allows thirty-seven one half to the *Ionic Architrave* in Altitude; and as to the Form, it is much the same with that of *Vitruvius's* first Order.

The *Corinthian Architrave*, according to *Vitruvius*, ought to be half a Mod. in Height; but it is to be observed, that this is for the *Corinthian* Column without a Pedestal. This Member he divides into seven Parts, of which the uppermost is the *Cymatium*; the six remaining Parts he divides into twelve, of which he allots five to the upper *Fascia*; also allowing one Eighth of this *Fascia* for a *Bead* at its Foot, he allows four of the twelve Parts to the middle *Fascia*, and one Eighth of this *Fascia* for the *Bead* at its Foot, and makes the lower *Fascia* of the three remaining Parts.

The *Architrave* for the *Corinthian* Order with a Pedestal, according to *Vitruvius*, is allow'd a greater Altitude than that without, consisting of the same

Members, both as to Number and Form with the former Architrave, but differing in Dimensions.

The whole Altitude of the Architrave ought to be one quarter of the Altitude of the Column, nearly to two Eighths of the Body of the Column below, which is — to forty one half M. This Altitude he divides into seven equal Parts, and makes a *Cymatium* at the uppermost of these seven, and divides the six that remain into twelve equal Divisions; of which, five he allots to the upper *Fascia*, four to the middle, and three to the lower one. He subdivides the upper and middle *Fascia*, each into eight Parts, and allows one of these Eighths for a Bead at the Foot of each of these *Fascia*'s.

Palladio makes this Architrave to contain eight Parts, viz. one *List*, one *Cima*, three *Beads*, and three *Fascia*'s, the Height of all which he allows to be thirty-six M. Which are thus subdivided, viz. to the *List* (or upper Member) he allows two three quarters M. the next in Order is a *Cima*, and the next in Order is of two M. high. at the Foot of which is a Bead; after this is the upper *Fascia*, its Bead at its Foot, both which contain about thirteen one half M. After this is the middle *Fascia*, and its Bead at its Foot, which contain eight one Eighth M. and last of all, the lower *Fascia*, which is six one quarter M. in Height.

Scamozzi makes the whole Altitude of this Architrave to be forty M. Which he subdivides in-

to nine small Members, (beginning at the Top, and descending) a *List* of two M. a *Casement* three one quarter M. and an *Ogee* of two three quarters, a *Bead* of one one half M. a *Fascia* of twelve M. and its *Bead* of two M. the middle *Fascia* eight one half M. and its *Bead* one three Fifths M. and the lower *Fascia* six one half M. which being all added together, make forty M.

Vignola makes the *Corinthian Architrave* forty-five M. in Height and subdivides it into eight smaller Members, as *Palladio* doth, viz. a *List*, a *Cima*, three *Beads*, and three *Fascia*'s.

The *Composite Architrave*. *Vitruvius* makes the Architrave of this Column, and the Frieze and Cornice, all of an equal Height, viz. each of which is equal in Height to the Diameter of the Column above, just under the Capital, which is ten Twelfths of a Mod. fifty M. This Architrave he divides into six Parts, one of which is for the *Cymatium*, and its *Boultin* under it: This upper sixth Part he divides into four, and allows one of these four for the Fillet above the *Cima*, and the two next for the *Cima* itself; and appoints the Fourth, that remains, for the small *Boultin* under the *Cima*; and subdivides the other five grand Divisions into twelve minuter Parts, assigning five of them for the upper *Fascia*, four for the middle one, and three for lower; and also subdivides the middle *Fascia*'s each into eight Parts, allowing one of these Eighths for a Bead at the Foot of each of these *Fascia*'s.

Palladio makes this *Architrave* forty-five M. in Height, and distributes them into seven particular minuter Members (beginning at the Top, and so descending :) First, he allows two one Eighth M. to the *List*, four one Eighth to the *Casement*, to the *Ogee* nine one quarter, to the *Bead* one one quarter, to the upper *Fascia* fifteen M. two one quarter to the *Ogee* at its Foot, and eleven M. to the lower *Fascia*.

Scamozzi makes this *Architrave* forty M. in Height, which he distributes among these eight following Members, *viz.* (descending :) First a *List* of two M. Secondly, an *Ogee* of four one half M. Thirdly, an *Astragal* of two M. Fourthly, the upper *Fascia* of eleven three quarters M. Fifthly, a *Bead* at its Foot of two one quarter M. Sixthly, the middle *Fascia* of eight one half M. Seventhly, at its Foot, one one half M. Eighthly, the lower *Fascia* of six one half.

Vignola makes this *Architrave* forty-five M. in Height, which he divides into seven Members, a *List*, a *Casement*, a *Boulton*, a *Fillet*, a *Fascia*, a *Bead*, and a *Fascia*.

Measuring of Architraves: Architraves in Buildings (either of Brick or Stone) are usually done by the Foot lineal; and therefore, having taken the Length in Feet, you have also the Content at the same Time.

The Price of Architraves: That is different, according to the Breadth or Width of them. *Stone Architraves*, about Doors or Windows (according to Mr. *Wing*) are usually reckoned at a Penny an Inch in Breadth at one

Foot, *e. g.* if it be nine Inches broad, it's worth nine Pence a Foot, ten Inches ten Pence a Foot, &c.

The Faces of an *Architrave*, says M. *Le Clerc*, ought not to have Ornaments, but to be left plain; and particularly when the Frieze is enrich'd.

The Proportion of *Architraves* by equal Parts.

The *Ionian Architrave* is divided into nine, giving one and three Fourths, to the first Face, two and a half to the second, and three to the third; one and one Fourth to the *Ogee*, and one half Part to the *Fillet*: The Projection of the second and third Faces have a quarter of a Part each, and the Whole two of these Parts.

The *Corinthian Architrave* is divided into nine, giving one and a half to the first Face, one Fourth to the small *Bead*, two to the second Face, three Fourths to the small *Ogee*, two and a half to the third Face, half a Part to the *Bead*, one to the *Ogee*, and half a Part to the *Fillet*: The Projection of the second Face hath one Fourth of a Part, the third Face one of these Parts, and the Whole two.

The Height of the *Composite Architrave* into nine, giving two and a half to the first Face, one half Part to the *Ogee*, three and one half to the second Face; one Fourth to the *Astragal*, three Fourths to the *Ovolo*, one to the Hollow, and half a Part to the *Fillet*: The Projection of the second Face hath one half a Part, the *Ovolo* one and one Fourth, and the Whole two.

AREA properly denotes any plain Surface whereon we walk. The Word is *Latin*.

Area, in Architecture, signifies the Extent of a Floor, &c.

Area, in Geometry, denotes the Compass, or superficial Content of any Figure; thus *exempli gratia*, if a Plot of Ground be exactly square, and its Side be 30 Feet, the *Area* will be 30 multiplied by 30, i. e. 900 Feet.

ARITHMETICK [*Ἀριθμητική* of *ἀριθμός*, Gr. Number] is the Art of Numbering, or that Part of the Mathematicks which considers the Powers and Properties of Numbers, and teaches how to compute or calculate truly, and with Expedition and Ease.

Vulgar Arithmetick is that which is conversant about Integers and vulgar Fractions.

Decimal Arithmetick is the Doctrine of decimal Fractions.

Sexagesimal Arithmetick is the Doctrine of sexagesimal Fractions, or that which proceeds by Sixties.

Binary Arithmetick, $\{$ is an *Arithmetick*, $\}$ *Diadick Arithmetick*, $\}$ *Arithmetick* or Way of Numbering, wherein but two Figures, viz. Unity, or 1 and 0, are used.

Decadal Arithmetick is that which is wrought by a Series of ten Characters; so that the Progression is from 10 to 10, such as is the common Arithmetick which we use, wherein the ten *Arabick* Figures are used, as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, after which we begin 11, 12, &c.

Tetradick Arithmetick is that where only the Figures 1, 2, 3, and 0 are used.

Instrumental Arithmetick, is that where the common Rules are perform'd by Means of Instruments, contriv'd for Ease and Dispatch, as by the Lines on a common Carpenter's Rule, a Sector, Napier's Bones, &c.

Numerous Arithmetick is that which gives the *Calculus* of Numbers, or indeterminate Quantities, and is perform'd by the common Numeral, or *Arabick* Characters.

Specious Arithmetick, is that which gives the *Calculus* of Quantities, using Letters of the Alphabet instead of Figures, to denote the Quantities, commonly called **ALGEBRA**.

Theoretical Arithmetick is the Science of the Properties, Relations, &c. of Numbers considered abstractedly, with the Reasons and Demonstrations of the several Rules of Arithmetick.

Practical Arithmetick is the Art of computing, that is, from certain Numbers given, to find others whose Relation to the former is not known.

Political Arithmetick is the Application of Arithmetick to Political Subjects, as the Revenues of Princes, Number of Subjects, Births, Burials, &c.

Arithmetick of Infinites, is the Method of summing up a Series of Numbers, consisting of infinite Terms, or of finding the Ratio's of them.

ARRANGEMENT, the Disposition of the Parts of a Whole in a certain Order.

ARSENAL, a Royal or Publick Building, or Magazine, for the making and keeping of Arms, necessary

necessary either for Defence or Assault.

ARTICLE, in Arithmetick, signifies the Number 10, or any Number justly divisible into ten Parts, as 20, 30, 40, &c. which are sometimes called *round Numbers*, and sometimes *Decades*.

ASH, next to the Oak itself, is reckon'd one of the most useful Sorts of Timber we have, serving for so many Uses for the Carpenter, the Cooper, &c. and like the Elm, is good for Mortises, Tenons, &c.

The Price of sawing Ash: In some Places, they have 3*s.* per Hundred, in others 3*s.* 6*d.* and sometimes 4*s.* the Price varying according to the Custom of the Place; but it is certain, it is worth 6*d.* per Hundred at least, more than 'tis to saw Oak.

ASHLAR, a Term used by Builders, by which they mean common Freestones, as they come out of the Quarry, of different Lengths and Thicknesses. Nine Inches is the common Thickness.

As to the Price of Ashlars: Mr. Wing says, that they commonly value them in Rutland at 3*d.* the Foot in the Quarry.

In *Sussex* and *Kent* they commonly sell them by the Load, being a common or ordinary Sort of Stone. About eighteen or twenty Foot makes a Load; which, if they come rough from the Quarry, cost about 3*d.* a Foot, laid down at the Place where they are to be used; but if they are ready scaped, they are reckon'd at 4*d.* the Foot.

But if they are bought rough at the Quarry, they may be had

at 2*d.* a Foot; but if scaped, 3*d.* And in some Places of *Kent* and *Sussex*, they may be bought rough at the Quarry for three Halfpence a Foot, and scaped for two Pence Half-Penny; but if they are laid down at the Place rough, then they are usually reckon'd at two Pence Halfpenny a Foot, and if ready scaped, at three Pence Halfpenny a Foot.

But Places differing as to the Price of *Ashlar*, it is impossible to give a certain Rule for the Price; which is different, First, according to the different Customs of the Places; Secondly, the Circumstances of the Quarry; And, Thirdly, the Goodness of the *Ashlar*.

1. As to the Custom of the Place, in respect to Carriage, Stones in one Place have been carry'd above a Mile for 1*s.* 8*d.* a Load, and at another Place, have cost 2*s.* a Load, for carrying them half a Mile.

2. As to the Circumstances of the Quarry. As, First, whether the Stones be drawn on inclosed Land, on the Lord's Waste, *viz.* on the Highways, or on Commons, &c.

For if they are drawn within Land, (as they commonly call it,) the Person who is the Proprietor of the Land, will be paid well for the Damage done to his Ground, both by drawing and carrying the Stones out of his Land. But if they are drawn on the Lord's Waste, the Lord has usually no more than a small Acknowledgement, either by Load, or otherwise, for trespassing upon his Waste.

3. As to the Goodness of the Stones, either for their Durableness, or Largeness. As for their Durableness, that only is to be known by Experience; For at the first opening of a new Quarry, no body can tell how the Stones may prove. For some Stones, when first taken out of the Quarry, are very soft and friable, and will moulder to Sand, by being expos'd to the Weather but a few Years: Whereas others of those soft Stones will be indurated, or hardened, by being expos'd to the open Air.

First, Those Stones that come hard out of the Quarry, are generally durable, being of a more firm and solid Consistence.

Secondly, as to their Largeness, I need not say much, all knowing that large Stones must needs be better, and make firmer Work than small ones; which are only fit for filling Work in thick Walls; or to be used in such Places where the Country affords no better.

There is a great Difference in Quarries, in respect to the Position of the Stones in the Ground; which may be consider'd under two Heads, *viz.* First, as to their Depth in the Ground: For when they lie a considerable Depth in the Ground, it requires a great deal of Labour to uncover them, (as they term it) *i. e.* to remove the Earth. Secondly, if they do lie almost even with the Surface of the Ground, then it will require the less Labour to uncover them.

And besides, an Allowance is to be made, as to the Manner of their lying in the Ground: For of the Quarry is a Rock.

In this Case, it requires the more Labour to raise the Stones, and break them fit for Use, than if they lay separate and dis-united: So that these Circumstances so vary the Price, that some have been drawn for nine Pence the Load, when others have cost three Shillings.

ASHLERING [with Builders] Quartering to tack to in Garrets, about two Foot and a half or three Foot high, perpendicular to the Floor, up to the Underfide of the Rafters.

The Workmanship is from 4d. to 6d a Square.

ASSEMBLAGE, the Joining or Uniting of several Things together; also the Things themselves so joined or united: Of which Assemblages, there are divers Kinds and Forms used by Joiners, as with Mortoises, Tenons, Dove-tails, &c.

Assemblage of Orders. M. Le Clerc says, when two Columns are placed one over another, they must be of different Orders, the Stronger always to support the Weaker.

For Instance, 1. The *Doric* may be placed over the *Tuscan*, the *Ionic* over the *Doric*, the *Roman* over the *Ionic*, the *Spanish* over the *Roman*, and the *Corinthian* over the *Spanish*.

2. That the upper Order must always be less massive than the under, agreeable to the Maxim, *That the Strong ought to support the Weak.*

3. That the Columns ought to stand exactly over each other; so that their two Axis's may be both found in the same Perpendicular.

4. The

4. The Distances between the lower Columns, must be determined by the Intercolumniations of the Order, that is, without Pedestals; and the Distances of the upper Columns, by the Intercolumniations of the Order, with Pedestals, taking Care, by the Way, that the first Order be mounted on a pretty high Zocle, or an Ascent of several Steps, to serve instead of a continu'd Pedestal, or Foot.

He gives a Pedestal to the upper Order; because being confin'd to the Breadth of the Inter-columniation of the lower Order, its Columns, by this Means, are render'd smaller, insomuch, that the Diameter of their Base does not exceed that of the Top of the under Column; which is a Kule (in his Opinion) not to be dispensed withal.

He remarks that *Vitruvius* will not allow the upper Order more than three quarters of the Height of the under.

But if this Reduction were follow'd, the Columns would be too small, and consequently too far asunder, with respect to their Height, if placed one over another.

In order to find the Mod. of an Order that is to be placed over another, he proposes, for Instance, to place the *Ionic* over the *Doric*; and advises,

To consider, first, that in the *Doric* Order, without a Pedestal, which is to give the Measures of that first Order, that the Columns are placed at the Distance of eleven M. from each other, in Portico's.

That in the *Ionic* Order with a Pedestal, the Columns

are fifteen M. a-part; and that to place this Order upon the *Doric*, you must divide the Inter-column, or its Equal, into fifteen equal Parts; one of which fifteen will be the M. for raising the *Ionic* Order, with its Pedestal.

He likewise observes, that when two Portico's are placed over each other, the higher ought to be regulated by the lower: He means, that the Width of the upper Arch should be made equal to that of the under; it being but just, that the two Arches should have the same Width.

On such an Occasion, the lower Arch may be made ten or twelve Minutes narrower than usual, that the Width of the upper Arch may be better proportion'd.

When Columns are to be without Portico's, he says, there needs only be four Triglyphs made between the *Doric* Columns, that is, an Interval of eight Mod. four Minutes, which are equivalent to twelve M. in the *Ionic*, as appears by the Rule of Proportion; and that the same Thing may be observed of coupled Columns.

The *Roman* Order, he says, does not match perfectly well with the *Ionic*; because its Capital is higher, with respect to its Column, than the *Ionic* Capital, with respect to the *Ionic* Column; and because the Denticles of the *Ionic* appear somewhat weak underneath the Modillions of the *Roman*.

However, the *Roman* Order being in this Place less than the *Ionic*, the Disproportion between

tween their Capitals, becomes less sensible, as well as that between the Denticles of the one, and the Modillions of the other.

To find the *M.* for raising a Corinthian Column over a Spanish Order he says,

It is evident, that the Modillions of the Upper Order must be the same in Number with those of the Under, in order to have them exactly one over another.

Now the Inter-Modillions of the Corinthian Order containing just 40 Minutes, where the Column has no Pedestal, these 40 Minutes must be multiplied by the Number of Modillions; which being 11, the Product will be 440; which being divided by 30, the Mod. the Quotient will be 14 M. 20 Minutes; which is the Division of the Scale for raising the Corinthian Order.

He observes, that there is a Difficulty in placing three Orders over each other; which consists in this; That the Second Order having a Pedestal, the Columns of the Third become a little too big at the Bottom; though 'tis so very little, that the Eye can hardly perceive it. But this Inconveniency, however, may be remedied, by taking the Excess away imperceptibly, wholly from the Base of the Column. It is true, this will occasion a little Swelling; but that won't do any Harm.

Again, he is of Opinion, it would not be proper to undertake the placing of more than three Orders of Columns over one another.

For, besides that in the fourth Order, the Columns would be too far asunder, in respect to their Height, it ought likewise to be consider'd, that four Columns raised over one another, can't well be very strong: Indeed, the first may have a Rustick Order, whereon it is raised, and which may serve it as a Foot.

Assemblage of Pilasters. See PILASTER.

ASTRAGAL [*Ἀστράγαλος*, *Gr.* which signifies the Ankle, or Ankle-Bone] is, in Architecture, a little round Member, in the Form of a Ring, or Bracelet, serving as an Ornament at the Tops and Bottoms of Columns.

The *Astragal* is also sometimes used to separate the *Fasciæ* of the Architrave. In which Case, it is wrought in Chaplets, or Beads and Berries.

It is also used both above and below the Lists adjoining immediately to the Dye or Square of the Pedestal.

The *Astragal* of a Column, *M. Le Clerc* says, ought always to be plain, excepting in the *Ionie* Order, where the Astragal of the Shaft is converted into a Chaplet of Pearls and Olives, for the Capital.

Astragal or *Baguette*, has the Figure of a Staff, when it is join'd to a Fillet; the Height of which Fillet, *M. Le Clerc* divides into three Parts; two of which, he gives to the Astragal. And this Rule, he says, he observes on all Occasions.

This *Astragal* is frequently carv'd with Pearls and Olives, which the *French* call *Pater-nosters*.

ASYMMETRY, a Want of Symmetry, or Proportion.

ASYMPTOTES, are properly Straight Lines, which approach nearer and nearer to the Curve, they are said to be Asymptotes of; but if they and their Curve are indefinitely continu'd, they will never meet.

Or *Asymptotes*, are Tangents to their Curves, at an infinite Distance.

And two Curves are said to be asymptotical, when they continually approach to one another; and if indefinitely continu'd, do not meet.

As two Parabola's, which have their Axis placed in the same Straight Line, are asymptotical to one another.

Of Curves of the second Kind, that is the Conic Sections only, the Hyperbola has Asymptotes, being two in Number.

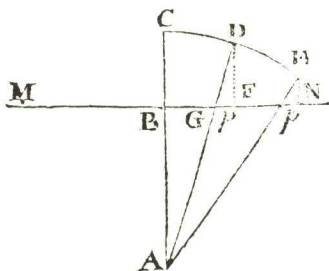
All Curves of the third Kind, have at least one Asymptote; but they may have three.

And all Curves of the fourth Kind, may have four Asymptotes.

The *Conchoid*, *Cissoïd*, and *Logarithmick* Curve, have each one Asymptote.

The Nature of an *Asymptote* will be very easily conceiv'd from that of the *Conchoid*: For if CDE be a Part of the Curve of the Conchoid, and A its Pole, and the Right Line MN be so drawn, that the Parts BCGD FE, &c. of Right Lines drawn from the Pole A, be equal to each other, then the Line MN will

be the Asymptote of the Curve, because the Perpendicular Dp is shorter than BC, and Ep than



Dp, and so on; and the Points E, &c. and p, can never coincide.

ATLASSES [in *Architecture*] a Name given to those Figures, or half Figures of Men, so commonly used instead of Columns or Pilasters, to support any Member in *Architecture*, as a Balcony, or the like. These are otherwise called *Telamones*.

ATTIC, signifies something relating to *Attica*, or the City of *Athens*.

Attic is also used in *Architecture* for a kind of Building, wherein there is no Roof or Covering to be seen; thus called, because usual at *Athens*.

Attic, or *Attic Order*, is a sort of little Order raised upon a larger one, by Way of Crowning, or to finish the Building.

It is also sometimes used for the Convenience of having a Wardrobe, or the like, and instead of regular Columns, has only Pilasters of a particular Form.

Attic Order, according to *M. Le Clerc*, is a kind of rich Pedestal,

Ital. Some Architects give it the several Capitals of all the Orders of Columns; but he says, the *Ionic*, *Roman*, and *Corinthian*, do not at all become it. The best Way, in his Opinion, is only to distinguish the Capitals by a Difference in their Mouldings; which may be made more or less simple, and more or less delicate, according to the Relation they are to bear to the Architecture underneath.

The Name *Attic*, is also given to a whole Story, into which this Order enters; this little Order being always found over another that is greater.

This Pedestal, or false Pilaster, he says, ought always to have the same Breadth with the Column or Pilaster underneath; and its Height may be equal to a Third, or even a Half of the same Column or Pilaster, by which it is supported.

Attic of a Roof, is a kind of a Parapet to a Terras, Platform, and the like.

Attic continu'd, is that which encompasses the whole Pourtour of a Building, without any Interruption, following all the Jets, the Returns of the Pavilions, &c.

Attic interpos'd, is one situate between two tall Stones, sometimes adorn'd with Columns or Pilasters.

Attic Base, is a peculiar Kind of Base used in the *Ionic* Order by the antient Architects; and also by *Palladio*, and other Moderns, in the *Doric*. It is the most beautiful of all Bases.

ATTITUDE [in *Sculpture* and *Painting*] is the Posture of

a Statue or Figure, or the Disposition of its Parts; by which, we discover the Action it is engaged in, and the very Sentiments supposed to be in its Mind.

The representing these in a strong and lively Manner, makes what they call a good Expression.

The Word comes from the *Italian Attitudo*, which signifies the same Thing.

ATTRIBUTES [in *Sculpture*, &c.] are Symbols added to several Figures, to denote their particular Office and Character; as a Club is the Attribute of *Hercules*; a Trident, of *Nep-tune*; a Palm, of *Victory*; the Eagle, of *Jupiter*; a Peacock, of *Juno*, &c.

AVIARY, a House or Apartment for the keeping, feeding, and breeding of Birds.

AUREOLA, a kind of Crown of Glory, given by Statuaries, &c. to Saints, Martyrs, &c. as a Mark of the Victory they have obtain'd.

AXIS properly signifies a Line or long Piece of Iron, or Wood, passing through the Centre of a Sphere, which is moveable upon the same.

Spiral Axis, in Architecture, is the Axis of a twisted Column drawn spirally, in order to trace the Circumvolutions without.

Axis of the *Ionic* Capital, is a Line passing perpendicularly through the Middle of the Eye of the Volute.

Axis, in *Mechanicks*, as the *Axis* of a Balance is the Line upon which it moves or turns.

Axis of Rotation, or Circumvolution, in Geometry, is an imaginary Right Line, about which any plain Figure is conceived to revolve, in order to generate a Solid

Thus a Sphere is conceived to be form'd by the Rotation of a Semicircle about its Diameter, or Axis, and a Right Cone by that of Right-angled Triangle about its perpendicular Leg; which is here its Axis.

Axis of a Circle or Sphere, is a Right Line passing through the Circle or Sphere, and terminating at each End in the Circumference of it.

Axis is yet more generally used for a Right Line proceeding from the Vertex of a Figure, to the Base of it.

Axis of a Cylinder, is properly that quiescent Right Line about which the Parallelogram turns, by the Revolution of which the Cylinder is form'd.

Though both in Right and Oblique Cylinders, the Right Line joining the Centres of the opposite Bases, is also called the Axis of the Cylinder.

Axis of a Cone, is a Right Line or Side upon which the Right-angled Triangle forming the Cone, makes its Motion.

Axis of a Vessel, is that quiescent Right Line passing through the Middle of it perpendicularly to its Base, and equally distant from its Sides.

Axis of a Conic Section, is a quiescent Right Line passing through the Middle of the Figure, and cutting all the Ordinates at Right Angles.

Axis in Opticks, is a Ray passing through the Centre of the

Eye; or it is that Ray, which proceeding out of the Middle of the luminous Cone, falls perpendicularly on the Chrystalline Humour, and consequently passes through the Centre of the Eye.

Axis of Oscillation, is a Right Line parallel to the Horizon passing through the Centre, about which a Pendulum vibrates.

Common or Mean Axis, is a Right Line drawn from the Point of Concourse of the two Optick Nerves, through $\dagger$, which joins the Extremity of the same Optick Nerves.

Axis of a Lens, or Glass, is a Right Line passing along the Axis of that Solid, of which that Lens is a Segment.

Thus a Spherical Convex Lens being a Segment of some Sphere, the *Axis* of the *Lens* is the *Axis* of the *Sphere*; or it is a Right Line passing through the Centre of it.

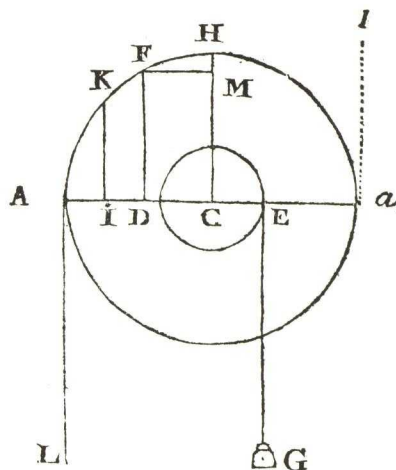
Axis of Incidence, in Dioptricks, is a Right Line drawn through the Point of Incidence perpendicularly to the refracting Surface.

Axis of Refraction, is a Right Line, continu'd from the Point of Incidence, or Refraction, perpendicular to the refracting Surface along the further Medium.

Spiral Axis, in Architecture, is the Axis of a twisted Column drawn spirally, in order to trace the Circumvolutions without.

Axis of the Ionic Capital, is a Line passing perpendicularly through the Middle of the Volute.

The *Axis in Peritrochio* consists of a Circle concentrick with the Base of the Cylinder, and is moveable together with it about its Axis.



The Cylinder is called the *Axis*; the Circle the *Peritrochium*; and the *Radii*, or Spokes, which are sometimes fitted immediately into the Cylinder, without any Circle, the *Scytale*.

Round the *Axis* winds a Rope, whereby the Weight, &c. is to be raised.

The *Axis in Peritrochio* takes Place in the Motion of every Machine, where a Circle may be conceiv'd, describ'd about a fix'd Axis, concentrick to the Plane of a Cylinder, about which it is placed; as in Crane-Wheels, Mill-Wheels, Capstans, &c. See WHEEL.

The Doctrine of the *Axis in Peritrochio*, is as follows:

1. If the Power apply'd to an *Axis in Peritrochio*, in the Direction AL perpendicular to the Periphery of the Wheel, or to

the Spoke, be a Weight G, as the Radius of the Axis GC is to the Radius of the Wheel CA, or the Length of the Spoke, the Power will just sustain the Weight, i. e. the Weight and Power will be *in equilibrio*.

2. If a Power be apply'd to the Wheel in F, according to the Line of the Direction FD, which is oblique to the Radius of the Wheel, though parallel to the perpendicular Direction, it will have the same Proportion to a Power; which acts according to the perpendicular Direction AL, which the whole Sine has to the Sine of the Angle of the Direction DFC.

Hence, since the Distance of the Power in A, is the Radius CA, the Angle of Direction being given, the Distance DEC, is easily found.

3. Powers

3. Powers apply'd to the Wheel, in several Points F and K, according to the Directions FD, and KI, and I parallel to the Perpendicular on AL, are to each other, as the Distances from the Centre of Motion CD, and DI reciprocally.

Hence, as the Distance from the Centre of Motion increases, the Power decreases, and *vice versa*.

Hence also, since the Radius AC is the greatest Distance, and agrees to the Power, acting according to the Line of Direction, the perpendicular Power will be the smallest of all those able to sustain the Weight G, according to the several Lines of Direction.

4. If a Power, acting according to the Perpendicular AL, lift the Weight G, the Space of the Power will be to the Space of the Weight, as the Weight to the Power; for in each Revolution of the Wheel, the Power passes through its whole Periphery; and in the same Time, the Weight is rais'd equal to the Periphery of the *Axis*: The Space of the Power, therefore, is to the Space of the Weight, as the Periphery of the Wheel to that of the *Axis*: But the Power is to the Weights, as the Radius of the *Axis* is to that of the Wheel; therefore, &c.

5. A Power and Weight being given to construct an *Axis* in Peritrochio, whereby it shall be sustain'd.

Let the Radius of the *Axis* be big enough to support the Weight without breaking. Then, as the Power is to the Weight, so make the Radius of the Wheel, or the Length of the Spoke, to the Radius of the *Axis*.

Hence, if the Power be but a small Part of the Weight, the Radius of the Wheel must be vastly great, *ex. gr.* suppose the Weight 3000, and the Power 50, the Radius of the Wheel will be to that of the *Axis*, as 60 to 1.

This Inconvenience is provided against by increasing the Number of Wheels, and *Axes*, and making one turn round another, by Means of Teeth, or Pinions. See WHEEL, and PERITROCHIO.

B A.

BACK. See BAGUETTE. BACK-NAILS, a Sort of Nails made with flat Shanks, so as to hold fast, and not to open the Grain of the Wood, used in nailing Guts together, for saving Water under the Eaves of a House; or by Back-Makers, in nailing of Boards together for Coolers, or any Vessels made of Planks or Boards for containing Liquors.

BACULOMETRY, the Art of measuring accessible or inaccessible Lines, by the Help of one or more Staves.

BAGNIO, an *Italian* Term, signifying a Bath. Thence *Bagnio* is become a general Name in *Turky*, for the Prisons in which the Slaves are confin'd, it being usual to have Baths in those Prisons.

BAKE-HOUSE, is a Room of Office, or an Apartment belonging to noble Buildings, and other private Buildings, in which an Oven is built.

As to the Position, it ought (according to the Rules laid down by Sir Henry Wotton) to be pla-

ced on the South-Side of any Building.

BAGUETTE [in *Architecture*] a little round Moulding, less than an *Astragal*; sometimes carv'd and enrich'd with Foliages, Pearls, Ribands, Lawrels, &c. Though, according to *M. Le Clerc*, when a *Baguette* is enrich'd with Ornaments, its Name is chang'd, and it is called a *Chaplet*. Or *Baguette*, is a Term used by Carpenters, for a kind of *Astragal*, or Hip-Moulding; by which is meant the outward Angle, or the Hips or Corners of a Roof; which in Square Frames, where the Roof is three quarters pitch, contains an Angle of one hundred and sixteen Degrees and twelve Minutes.

BALANCE, in *Mechanicks*, is one of the six simple Powers principally used for determining the Equality or Difference of Weights in heavy Bodies, and consequently other Masses and Quantities of Matter.

The *Balance* is of two Kinds, viz. the *Antient* and *Modern*.

The *Antient*, or *Roman*, called the *Statera Romana*, or *Steel-Yard*, consists of a Lever, or Beam, moveable on a Centre, and suspended near one of its Extremes: On one Side the Centre are applied the Bodies to be weigh'd, and their Weight measured by the Divisions mark'd on the Beam, in a Place where a Weight moveable along the Beam, being fix'd, keeps the *Balance in equilibrio*. This is still in use in Markets, &c. where large Bodies are to be weigh'd.

The *modern Balance* now ordinarily in use, consists of a Lever, or Beam, suspended exactly

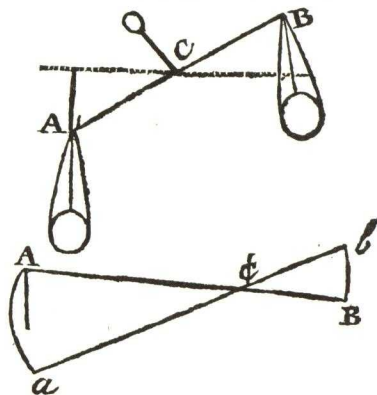
by the Middle, to the *Extremes* whereof are hung Scales.

In each Case the Beam is called the *Brachia*; the Line on which the Beam turns, or which divides its *Brachia*, is called the *Axis*; and when considered with respect to the Length of the *Brachia*, is esteem'd but a Point, and called the *Centre of the Balance*; and the Places where the Weights are applied, the *Points of Suspension, or Application*.

In the *Roman Balance*, therefore, the Weight used for a Counter Balance is the same; but the Points of Application various: In the common Balance, the Counterpoise is various, and the Points of Application the same. The Principle on which each is found is the same, and may be conceiv'd from what follows.

The Doctrine of the Balance.

The Beam AB, the principal Part of the Balance, is a Lever



of the first Kind, which (instead of resting on a *Fulcrum* at C, the Centre of its Motion) is suspended by something fastened to C, its Centre of

of Motion. Hence the Mechanism of the Balance depends on the same Theorem as that of the Lever. See the *Figure*.

Wherefore as the known Weight is to the unknown, so is the Distance of the unknown Weight from the Centre of Motion to the Distance of that of the known, where the two Weights will counterpoise each other; consequently the known Weight shews the Quantity of the unknown Weight: Or thus, the Action of a Weight to move a Balance is by so much greater, as the Point press'd by the Weight is more press'd distant from the Centre of the Balance, and that Action follows the Proportion of the Distance of the said Point from that Centre.

When the Balance moves about its Centre, the Point B describes the Arch *Bb*, whilst the Point A describes the Arch *Aa*, which is the biggest of the two; therefore in that Motion of the Balance, the Action of the same Weight is different, according to the Point to which it is applied: Hence it follows, that the Proportion of the Space gone through by that Point at A, is *Aa*, and at B as *Bb*; but those Arches are to one another as *CB*, *CA*.

Varieties in the Application of a Balance.

If the *Brachia* of a Balance be divided into equal Parts, one Ounce apply'd to the ninth Division from the Centre, will equiponderate with three Ounces at the third; and two Ounces at the sixth Division, act as strongly as three at the fourth, &c.

Hence it follows, that the Action of a Power to move a Ba-

lance is in a Ratio compounded of the Power itself, and its Distance from the Centre; for that Distance is as the Space gone through in the Motion of the Balance.

It may be here observed, that the Weight equally presses the Point of Suspension at whatever Height it hangs from it, and in the same Manner as if it was fixed at that very Point; for the Weight at all Heights equally stretches the Cord by which it hangs.

A Balance is said to be in *equilibrium*, when the Actions of the Weights upon each *Brachium* to move the Balance are equal, so as mutually to destroy each other.

When a Balance is in *equilibrium*, the Weights on each Side are said to equiponderate. Unequal Weights may also equiponderate; but then the Distances from the Centre must be reciprocally as the Weight. In which Case, if each Weight be multiplied by its Distance, the Product will be equal; which is the Foundation of the Steel-Yard.

Thus in a Balance, whose *Brachia* are very unequal, a Scale hanging at the shortest, and the longest divided into equal Parts; if such a Weight be applied to it, as at the first Division shall equiponderate with one Ounce in the Scale, and the Body to be weigh'd put into the Scale, and the above-mentioned Weight be moved along the longest *Brachium*, till the *equilibrium* be found, the Number of Divisions between the Body and the Centre, shews the Number of Ounces that the Body weighs; and the

the Subdivisions the Parts of an Ounce.

On the same Principle also is founded the *deceitful Balance*, which cheats by the Inequality of the *Brachia*: For instance; Take two Scales of unequal Weights, in the Proportion of nine to ten, and hang one of them at the tenth Division of the *Balance* above described; and the other at the ninth Division, so that there may be an *Æquilibrium*; if then you take any Weights, which are to one another as nine to ten, and put the first in the first Scale, and the second in the other Scale, they will equiponderate.

Several Weights hanging at several Distances on one Side, may equiponderate with a single Weight on the other Side: To do this, it is required, that the Product of that Weight, by its Distance from the Centre, be equal to the Sum of the Products of all the other Weights, each being multiplied by its Distance from the Centre. To demonstrate which, hang three Weights of an Ounce each at the second, third, and fifth Divisions from the Centre, and they will equiponderate with one single Ounce apply'd at the tenth Division of the other *Brachium*; and the Weight of one Ounce at the sixth Division, and another of three Ounces at the fourth Division, will equiponderate with the Weight of two Ounces on the other Side at the ninth Division.

Several Weights unequal in Number on either Side, may equiponderate: In this Case, if each of them be multiplied by its Distance from the Centre, the Sums of the Product on either Side

will be equal; and if those Sums are equal, there will be an *Æquilibrium*.

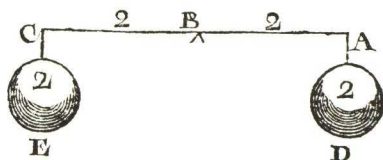
To prove which, hang on a Weight of two Ounces at the fifth Division, and two others, each of one Ounce, at the second and seventh; on the other Side hang two Weights, each also of one Ounce, at the ninth and tenth Divisions; and these two will equiponderate with those three.

To the Perfection of a *Balance* 'tis required, that the Points of Suspension be exactly in the same Line as the Centre of the *Balance*, that they be precisely equidistant from that Point on either Side; that the *Brachia* be as long as conveniently they may; that there be as little Friction as possible in the Motion of the Beam and Scales; and lastly, that the Centre of Gravity of the Beam be placed a little below the Centre of Motion.

First, Note that AC taken together, are called the Beam of the Balance.

The Point B, the fix'd Point on which it moves, and equally divides AB and BC, which are called two *Brachia*'s.

THEOREM.



If two Weights tied to the End of an horizontal *Balance*, are to one another reciprocally, as their Distance from the fix'd Point, they will hang in *equilibrio*.

B A

B A

DEMONSTRATION I. DEMONSTRATION II.

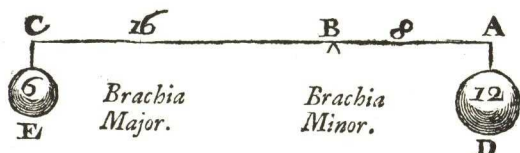
Of Equal Brachia's.

Of Unequal Brachia's.

Let $AB=BC$, and the Weight $D=E$, then I say, as $D 2 : E 2$
 $:: AB : BC$.

Or, as $D 2 : BC :: E 2 : A$
 B , which was to be demon-
 strated.

1. Let B be the fix'd Point.
2. Let AC be $= 24$ Feet.
3. Let $AB=8$ and $BC=16$.
4. Let the Weight $D=12$
 Pound, and $E=6$ Pound. Then
 I say,



As the Lesser Brachia $AB 8$
 is to the lesser Weight $E 6$, so is
 the Greater Brachia $BC 16$
 to the greater Weight $D 12$,
 which is requir'd to equipoize E .

Or, as the Lesser Brachia $AB 8$
 is to the Greater Brachia $BC 16$,
 so is the Power apply'd at C , viz.
 $E 6$, to the Weight it will equi-
 poize at A , viz. $D 12$. Q. E. D.

As the Sum of both Weights,
 18 , is to the lesser Weight $D 6$,
 so is the whole Balance $AC 24$
 to the lesser Brachia $AB 8$; or
 as the Sum of $D + E$ is to AC .
 So is the greater Weight $D 12$
 to the Greater Brachia $BC 16$:
 Therefore it is evident, that the
 Point B is the fixed Point or
 Centre of Motion required Q. E.
 D . See the preceding Figure.

PROPOSITION II.

The Weight of two heavy Bo-
 dies being known, apply'd to the
 Ends of a Balance of a known
 Length, to find upon that
 Balance the common fix'd
 Point, or Centre of Motion,
 whereon the two given Bodies
 will hang in *Equilibrio*.

DEMONSTRATION.

Let the Balance AB be $=$
 24 Foot.

The Weight $D=$ to 12 , and
 $E=$ to 6 : Then, I say,

N. B. It is here suppos'd,
 that the Balance AC is with-
 out Weight in itself, as a
 Line, &c. — as before
 noted.

PROPOSITION III.

The Length and Weight of a
 Balance being given, which has
 at one of its Ends, a Body of
 known Weight, to find the fix'd
 Point, about which the Weight
 of the Balance, and the Weight
 of the Body shall remain in *Equi-
 librio*.

E

1. Let

B A

B A

1. Let the Balance weigh 16 Pound, and its Length be 12 Feet.

2. The Body E 8 Pounds.

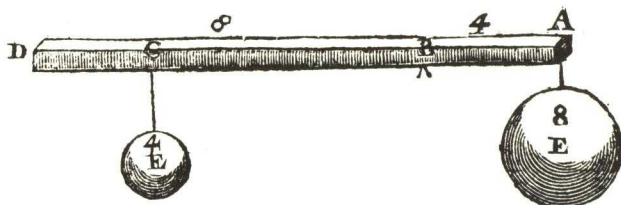
Then I say, as 24, the Sum of the Weights of the Balance 16

Pounds, and the Body 8 Pounds taken together, is to the whole

Length of the Balance 12 Feet;

So is 8 the Weight of the Body E to the lesser Brachia AB 4.

Or thus,



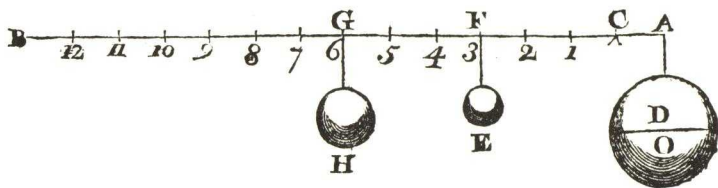
As 24, the Sum of the Weights of AD + E is to 12, the Length of the Balance, so is 16 the Weight of the Balance, to BD 8 the greater Brachia.

Therefore it is evident, that the Point B is the Point requir'd.

PROPOSITION IV.

Two Bodies being given, the

heaviest of which hangs at one of the Ends of a Balance of known Length and Weight, and given fix'd Point, (as Steel-Yards,) to hang that of least Weight in such Manner, that being assisted by the Weight of the Balance, it may keep the heaviest Body in *Equilibrium*.



1. Let the Balance AB weigh 2 Ounces, and 14 Inches long.

2. Let C be the fix'd Point, an Inch from the End A, and let the Part D of Body DO, weigh 15 Ounces.

3. Let E be a Body of an Ounce, and moveable at Pleasure, to find the Point F, where the Body E, with the Assistance

of the Gravity of the Brachia CB of the Balance AB, shall keep the Weight DO in *equilibrium* about the Centre of Motion G.

4. Divide the Balance AB into two equal Parts at G, which (if made of equal Matter) will be its Centre of Gravity.

5. Suppose

5. Suppose the Body H to be in Weight equal to the Balance AB, viz. = 2 Ounces, to hang from the Point G.

Then as the Distance AC is to the Distance CG, so is the Weight H = the Weight of the Balance, to a fourth Proportional = one Part of the Weight DO, viz. = 12 Ounces; wherefore, the other Part of it remaining is = 3 Ounces.

Now again;

As 1 Ounce, the Weight of the Body E, is to the Part D, 12 Ounces, the last Number found; so the Distance of AC to 3, the Distance of F from C, whereon the Body E being hung, will keep the Body DO in *equilibrio*.

BALCONY, a Projecture beyond the Naked of a Wall or Building, supported by Pillars or Consoles, and encompassed with a Balustrade. Or it is a kind of open Gallery for People to stand in to behold any publick Shew, as Pageants, Cavalcades, publick Entries of Ambassadors, &c. in Cities; or for taking the Air, &c.

This jutting or projective Building is usually placed in the Middle of a Front of a House, or publick Hall, &c. if there be but one; and is usually level with the first Floor, up one Pair of Stairs.

Some of these are made with Wood, and others with Iron; Wooden Balconies consist of Rails and Balusters; and so sometimes do those of Iron; but at other Times, are made of Cast-Iron, of various Figures in Semi-Relief; and some again, of

wrought Iron, in Crail'd Work, or Flourishes, in different Forms, according to the Fancy of the Workman, &c.

As to the Price: Wooden Balconies are commonly paid for by the Yard, from 3s. to 5s. per Yard, according to the Workmanship the Carpenter bestows upon it.

Those of Iron are commonly paid for by the Pound or Hundred Weight, from 4d. to 8d. per Pound, according to the Curiosity of the Workmanship.

It may be proper here, to take Notice of what Sir Henry Wotton says concerning all In-lets and Out-lets, such as Balconies, Windows, &c. that they ought not to approach to near the Corner of Walls; it being an essential Error, to weaken that Part which strengthens all the rest.

This, says he, is a Precept well recorded, but ill practis'd, even by the *Italians* themselves; particularly at *Venice*; where he had observed divers *Pergoli*, or *Maucina*, (as they seem to be called by *Vitruvius*.) which are certain Balustraded Out-Standings, made for standing in, to satisfy the Curiosity of the Sight, very dangerously set forth upon the very Point itself of the Mural Angle.

M. Le Clerc says, the Parts of a Balcony are the Terras, the Balustrade that incloses it, and the Consoles which support it: Or, to explain himself the more accurately, a Balcony is a Piece of Architecture raised in the Air, inclosed with a Balustrade, and supported by a little Entablature,

whereof the Cornice, or uppermost Part, makes a Terras ; the Frieze and Architrave being only continu'd at the Bottom and Sides ; and the whole Balcony further supported by Consoles.

The Frieze is made with a little Sweep, that the Zocle of the Pedestal above may not appear ill-supported ; and that the Console coming to contract, or straighten itself at the Bottom, may do it the more gracefully ; without which, it would appear too heavy.

The Height of the Consoles may be equal to their Projecture ; but it will be an Addition both to the Beauty and Strength of the Work, if they be made higher.

A Balcony may be continu'd quite through the *Facade* of a Building, by adding Consoles, from Space to Space ; to be disposed between the Windows, which will be underneath.

He is of Opinion, that Iron Balconies will do much better than those of Stone, as being lighter, and less subject to Decay ; which, if they be gilt, they will be exceedingly magnificent, and a very proper Ornament for a Palace.

BALDACHIN [of *Baldachino*, *Ital.* *Baldagum*, *Fr.*] a Piece of Architecture, in Form of a Canopy, supported with Columns, and serving as a Crown or Covering to an Altar. It properly signifies a Canopy carry'd over the Host in *Roman* Catholic Countries. Some also give the Name *Baldachin* to a Shell over the Front-Door of an House.

BALKS, Poles or Rafter, over Out-Houses or Barns ;

and among Bricklayers, great Beams, such as are used in making Scaffolds ; also so some call great Pieces of Timber coming from beyond Seas by Floats.

BALLON, in *Architecture*, a *French* Term, used to signify the round Globe on the Top of a Peer, or Pillar.

BALUSTRADE, an Assemblage of one or more Rows of little turn'd Pillars, called Balusters, made of Marble, Iron, Wood, or Stone, of a Height fit for a Man to rest his Elbows upon, fixed upon a Terras, or the Top of a Building, or else to make a Separation between one Part of it and another.

BALUSTER, which is usually corruptly pronounced *Bannister*, is a small Column, or Pilaster of different Sizes, viz. from an Inch and three quarters, to four Inches square or Diameter : Their Dimensions and Forms are various, according to the Fancy of the Workman. They are frequently adorn'd with Mouldings.

Du Cange derives the Word from *Balastrum*, or *Balastrium*, a Place, among the Antients, where their Baths were rail'd in. Others derive the Name from *Baulastrum* in *Latin*, from *Βαλυστιν*, in the *Greek*, which signifies the Flower of a Wild Pomegranate ; which it is supposed to resemble.

As to their Use : They are placed with Rails on Stairs, in the Fronts of Galleries in Churches, &c. Also round Altar-Pieces in Churches, on Terras-Walks, and in Balconies and Platforms, &c.

As to their Price, with Rails, &c. of Wood, on Stairs, Balconies, Platforms, &c. according to the Work, about 3 *d.* per Yard, running Measure.

For turning them only, the usual Rate is 1 *d.* per Inch for Workmanship.

The Charge for painting them: Balustrades, with their Appurtenances, are usually painted by the Yard. They are customarily measur'd thus: Both Sides of the Balusters are measur'd as though they were flat Measure, including the Spaces between the Balusters; which being cast up in Feet and Parts, are reduced into Yards, like other flat Painting.

Mr. *Leyburn*. tells us, that he has seen the Experiment try'd by girting the Balusters, to find the Difference betwixt that Way, and measuring them, and the Spaces on both Sides, as though upon a Flat, and found that the Difference would not countervail the Trouble of Girting. But it is reasonably to be supposed, that they should be nearly the same, it being the common Practice to set them no more than their Square or Diameter asunder; and then the Planks make good the Spaces.

BALUSTERS, are a kind of BALISTERS, § little Pillars join'd by a Rail, at a convenient Height, for the Elbows to rest upon.

Of these, M. *Le Clerc* proposes various Forms, accommodated to the various Orders of Architecture, where Balustrades may be used.

By BALUSTRADE, he means a Series or Row of Balusters, with

their Rail, serving as a Tablette, or Rest to the Elbows; and at the same Time, as a Fence and Inclosure to Balconies, Altars, Terrasses, Stair-Cases, Water-Works, large Windows, &c.

Balustrades consist of one or more Ranges or Rows of Balusters, terminated by Pedestals of the same Height.

If in a Stone or Marble Balustrade, the Distance from one Pedestal to another, be too great for a Tablette or Rail of a single Stone, it must be made of two: In which Case, it will be proper to have the Juncture or Assemblage supported with a Dye, if a Baluster be judged too weak to sustain it.

He is of Opinion, that the Ranges ought to terminate in half Balusters, joined to the Pedestals. Though some Architects have other Sentiments.

Though there are Balusters of various Figures, he would have the round and the square have the Preference.

He also would have every Balustrade have its Zocle; though *Palladio*, indeed, gives an Instance of the contrary, in his *Egyptian Hall*, p. 110. But this, he says, is not to be imitated.

Round Balusters are not so heavy as the square ones: They are frequently made of very hard Stone, as that of *Lions*; which works better than any other Kind of Stone, except Marble. When it is desired to have a Balustrade richer, and more delicate than ordinary, such as are sometimes seen before Altars, it may be cast of Brass or Silver; unless, to save Expenses, it be thought better to have it of Wood

gilded; for such Balustrades may be made as rich in Ornaments as you please.

All Balustrades, being intended to be Breast-high, none should ever exceed three Foot and a quarter at most, nor be lower than two Foot and quarter at least. The Measures for this, to be taken from the Royal *Paris* Foot, which is to the *English* Foot, as 1068 to 1000.

He observes, that in the Balustrades of Stair-Cases, the Zocle should always be the Height of the Steps; and that the Balustrade terminates much better with a Pedestal on the Ground, than a Pedestal on the Descent.

And also, that whether the Pedestal be on the Descent, or not, it must always have a Buttress, in manner of a Console, to sustain and bear up against the Pressure of the Balustrade.

And that in Balustrades which are between Pedestals, without either Bases or Cornices, the Tablette should only consist of a Platband sustain'd by a Filler, or little Talon underneath; and the Zocle may have a little Cavetto over it.

Again, when a *Balustrade* is independant, the Pedestals may be proportioned to the Balusters; of which *M. Le Clerc* gives several Instances: But when it is used in Orders of Columns, whereon it has some Dependance, the Pedestals, in that Case, can't be managed at Pleasure.

If the Pedestals which terminate a *Balustrade*, be compleat and well-proportion'd to the Pillars which they support, their Cornices will be found too

weak to be continu'd alone, and so to serve for a Tablette to the *Balustrade*: Therefore it will be necessary to add a Platband underneath, which will make a Symmetry with that round the Table or Pannel of the Pedestal.

Instead of Balusters, there is sometimes an Entrelas of Crailled Work, which are not inferior to the others in Beauty. Of these, *M. Le Clerc* proposes various Designs in his Book.

These also may be further enrich'd by making the Wreaths, Roses, and Foliages, of Brasses; which would still do infinitely better if they were gilt.

These Entrelas should be made more or less delicate, according to the Places where they are to be used: As for Instance, those which are placed on a Top of a Building, and which can only be view'd from afar, should be less delicate, than those that are to be view'd near at hand.

BAND, in Architecture, is a general Name for any flat low Member, or on that is broad, and not very deep; which is also called *Face*, from the *Latin Fascia*, which *Vitruvius* uses for the same Thing. And sometimes *Fillet*, *Plinth*, &c.

BANDELET, [is derived from the *French Bandelette*, a little Fillet or Band] is any little Band or flat Moulding, as that which crowns the *Doric* Architrave. 'Tis also called *Tenia*, from the *Latin Tania*, which *Vitruvius* uses for the same Thing. It is also used by Architects, to signify the three Parts that compose an Architrave.

BANISTER,

BANISTER, See BALUSTER.

BARACK, ? [of *Baraccas*;

BARAQUE, } *Spanish*, little
Cabins which the Fishermen
make on the Sea-Shore] a Hut,
or little Lodge, for Soldiers in
a Camp: Those for the Horse,
were formerly called *Baracks*;
and those for the Foot *Huts*:
But now *Barack* is used indif-
ferently for both. They are ge-
nerally made, by fixing four
forked Poles in the Ground, and
laying four others across them;
afterwards the Walls are built up
with Sods, Wattles, or what pro-
per Materials the Place affords;
the Top is either planked,
thatched, or cover'd with Turf,
according as the Country sup-
plies them.

When an Army is in Winter
Quarters, the Soldiers usually
build Baracks; but in Summer,
only make Shift with Tents.

BARBACAN, ? [Some derive

BARBICAN, } it from the
French; but others, of *Barba-*
cane, Italian] a Canal, or Open-
ing left in the Wall, for Water
to come in and go out at, when
Buildings are erected in Places
liable to be overflow'd; or to
drain off the Water from a Ter-
ras. It is also used to signify an
Outwork in a Building.

BARGE-COURSE [with
Bricklayers] a Term used for
Part of the Tiling which projects
over without the principal Ras-
ters, in all Sorts of Buildings,
where there is either a Gable, or
a *Kirkin-Head*.

BARN, Mr. *Worlidge* advises,
as to the Situation of Barns, that
it will be very inconvenient to
build Barns, or Stables, or Pla-
ces for the like Uses, too near

to the Dwelling-House; because
Cattle, Poultry, &c. require to
be kept near to Barns, &c. which
would be an Annoyance to the
House.

As to the Prices of Framing,
&c. The Carcass of a Barn has
been built for 3*s.* 6*d.* per Square,
for Carpenters Work alone; and
8*s.* per Square has been given for
Carpenters Work, the Felling,
Hewing, and Sawing of his Tim-
ber-Boards, and finding Nails.

Some Workmen say, that the
Charge of a Square of building
of the Timber-Work of a Tim-
ber Barn may be computed in
the Manner following; viz. 4*s.*
a Square for the sawing the
Boards, (considering that they
lap over one another,) and the
staving of the Logs, 2*s.* a Square;
for sawing the Timber-Members,
3*s.* 6*d.* a Square; for framing
the Carcass, from 4*s.* to 7*s.*
a Square for the Value of the
Timber, reckoning the Price of
the Timber from 12*s.* to 21*s.* per
Ton; and one Ton to make 3
square of Frame in Barn-Work.

Rough Timber, is that un-
hew'd or unsquar'd; and a Ton of
rough Timber, has been reckon'd
equal to a Load of hew'd. From
these Computations, we may
compute the whole Value of a
Square of such Timber-Work to
be worth from 3*s.* 6*d.* to 16*s.*
6*d.* per Square.

BAKS of Iron, upright ones
for Windows; their usual Price
is three Pence Halfpenny, or four
Pence a Pound in *London*.

BAR-POSTS, a Sort of Posts,
two of which, and five Rails or
Bars, serve instead of a Gate, for
an Inlet into Fields and other
Inclosures: These Posts consist

each of five Mortoises; and the Posts are usually six Foot, or six Foot and a half long, four of which stand above the Ground.

These Posts are, in some Places, made by the Piece, viz. a Penny or three Halfpence per Post hewing, and a Halfpenny per Hole for mortising.

BASE [of *Βάσις*, Gr. Rest, Support, or Foundation] is used to signify any Body which bears another; but particularly for the lower Parts of a Column, and a Pedestal.

The *Base* is also sometimes called *Spira*, from *Spiræ*, the Folds of a Serpent laid at Rest, which form a Figure not much unlike it.

The *Base* of a Column, is that Part between the Shaft and the Pedestal, if there be any Pedestal; or if there be none, between the Shaft and the Plinth, or Zocle.

The *Base* is supposed to be the Foot of the Column; or, as some define it, it is that to a Column, that a Shoe is to a Man.

The Members or Ornaments whereof a *Base* is compos'd, are supposed by others, to have been originally design'd to represent the Iron Circles with which the Feet of Trees and Posts were girded, which supported the Houses of the Antients, in order to strengthen them.

The *Base* is different in the different Orders.

The *Tuscan Base* is the most simple of all Orders; consisting, according to some, only of a single *Tore*, besides the *Plinth*.

The *Doric Base* has an *Astragal* more than the *Tuscan*, altho' that was introduced by the Moderns.

The *Ionic Base* has a large *Tore* over two slender *Scotia's*, separa-

ted by two *Astragals*: But there are no *Bases* at all in the most antient Monuments of this Order; which Architects are at a Loss to account for.

The *Corinthian Base* has two *Tores*, two *Scotia's*, and two *Astragals*.

The *Composite Base* has an *Astragal* less than the *Corinthian*.

The *Attic Base*, is so denominated, because it was first used by the *Athenians*. It has two *Tores*, and a *Scotia*, and is very proper for *Ionic* and *Composite* Columns.

The Parts or Members exceed the Number of the Kinds; because some Authors differ from others in their Form, according to the Account following:

The *Tuscan Base*, according to *Vitruvius*, is to be one half Mod. in Height. This cross Member consists of three smaller Members, or Parts, viz. a *Plinth*, a *Torus*, and a *Fillet*; and is divided, and subdivided as follows: The whole Height being 30, is divided into two equal Parts; the lower of which Parts is for the *Plinth*; and the upper Part of the two is to be subdivided into three equal Parts; the upper of which is for the *Fillet*, and the lower, for the *Torus*.

Palladio also allows the Altitude of this *Base* to be thirty Minutes; which he distributes among three smaller Members, viz. a *Plinth*, or *Orlo*, a *Torus*, and a *Listella*, or *Cincture*; the *Plinth* is fifteen Minutes, the *Torus* twelve and a half, and the *Listella* two and a half high.

Scamozzi also allows thirty Minutes to the Altitude of this *Base*; but then he allows it but two

two Members, or Parts ; which are, a *Plinth* of eighteen Minutes, and a *Thorus* of twelve Minutes ; altho' at the same Time he places a *List* of three Minutes above the *Thorus*.

Vignola also makes this *Base* to consist of three Parts, a *Plinth*, *Thorus*, and *Fillet* : All which he reckons thirty Minutes—half a Module.

The *Doric Base*. This *Base* *Vitruvius* makes to consist of six Parts, viz. a *Plinth*, two *Thorus's*, one *Scotia*, and two *Lists* : To the whole Height of all these, he allows thirty Minutes, which he thus divides, viz. First, into three Parts ; the lower one of which is for the *Plinth*, and subdivides the two remaining Parts into four ; the upper one of which he allots to the upper *Thorus*, and the three lower Parts of these four he divides into two ; the lower of which two is for the lower *Thorus* : After which he subdivides the upper Part of these two into seven equal Parts ; the upper and lower of these seven Parts, are for the two *Lists*, and the five which are betwixt them, are for the *Scotia*.

But among all these six Members, or Parts of the *Base*, there is one large *Fillet*, which is one twelfth Part of the Mod. but he does not reckon this *Fillet* to be any Part of the *Base*, but a Part of the Body of the Column.

Palladio assigns thirty Minutes to the Height of this *Base* : According to his Scheme of this Member, it is composed of seven Parts, viz. a *Plinth*, two *Thorus's*, three *Annulets*, and a *Scotia*, or *Cavetto*, which he proportions as follows : To the *Plinth*, which is wrought hol-

low, (and might perhaps be more properly called a *Scotia*, or *Cavement*,) he allows ten Minutes ; to the lower *Thorus* seven one Third Minutes, and to the lower *Annulet*, One one Fourth Minute, and to the *Cavetto* Four two Thirds Minutes ; to the middle *Annulet* One one Fourth Minute, to the upper *Thorus* four one Fourth, and to the upper *Annulet* One one Fourth Minute.

Scamozzi makes the *Doric Base* thirty Minutes in Altitude, which are subdivided among six smaller Members, viz. 1st, a *Plinth*, (beginning below, and so ascending,) allowing to it ten Minutes one Sixth: 2^{dly}, A *Thorus* of eight Minutes. 3^{dly}, A *List* of one Minute. 4^{thly}, A *Scotia* of four Minutes. 5^{thly}, A *List* of one Minute. And 6^{thly}, A *Thorus* of five Minutes and a half. Above all these he places a *List* of two Minutes, which he does not reckon into the *Base*, but to the Part of the Body of the Column.

Vignola, in like manner, allows the Altitude of the *Base* to be one half of the Diameter of the Column below ; but he makes it to consist of but four Parts, viz. a *Plinth*, a large and a small *Thorus*, and a *List*.

The *Ionic Base*, according to *Vitruvius*, is half a Mod. in Height, and in this Order describes two Sorts of Bases ; the one for the *Ionic Column*, without a Pedestal, and the other for that with. Each of which Bases consists of smaller Members : But the Bases are different in the Dimensions of their Parts.

The Members of which they consist are these that follow, viz. a *Plinth*, four *Fillets*, two *Scotia's*,

tia's, two *Astragals*, and a *Thorus*.

First, as to the *Ionic Base* without a Pedestal. He divides and subdivides this Base as follows: He divides the whole Altitude of the Base into three equal Parts; the lower one of which is the Height of the *Plinth*, the two upper and remaining Parts he subdivides into seven equal Parts, the upper three of which make the *Thorus*; and the four Sevenths remaining, he subdivides into eight equal Parts; Half of the lower Eighth makes the lower *Fillet*; the other Half, and the second Eighth, and half the third Eighth, make the first *Scotia*; and the upper half of the third Eighth makes the second *Fillet*; the fourth and fifth makes the two *Astragals*; half the sixth Eighth makes the third *Fillet*; the upper half of the sixth Eighth, and all the seventh, and one Third of the last, or uppermost Eighth, makes the second *Scotia*; the two Thirds of the last Eighth which remains, makes the upper *Fillet* which subjoins to the *Thorus*. He also places another *Fillet* above the *Thorus*, which he does not account any Part of the Base, but a Part of the Body of the Column; which *Fillet* is one Twelfth of the Body of the Column, = five M.

The *Ionic Base*, with a Pedestal, according to *Vitruvius*, is divided into Parts, as follows: First, into three equal Parts, the lower of which is the Altitude of the *Plinth*; the two Thirds remaining, he divides into three equal Parts, the uppermost of which he assigns for the *Thorus*; and the two Thirds remaining,

he subdivides into twelve equal Parts; half the lower one Twelfth he assigns for the *Fillet* above the *Plinth*; the remaining Half of one Twelfth, and the three next Twelfths, make the first *Scotia*; the fifth Twelfth makes the second *Fillet*, the sixth and seventh make the two *Astragals*, and Half the eighth makes the next *Fillet*; the other Half of the eighth and ninth, tenth and eleventh, make the second *Scotia*; and the twelfth and last Part makes the upper *Fillet* which is under the *Thorus*.

There is also a *Fillet* above the *Thorus*, which is of the same Height with that without the Pedestal.

Palladio assigns thirty Minutes for the Height of this Base; and according to his Scheme of this Member, he divides it into six smaller Members, viz. 1st, A *Plinth*, or rather, as he delineates it, a *Casement* of ten Minutes. 2^{dly}, A *Thorus* of seven Minutes and a half. 3^{dly}, A *List* of one Minute one Fourth. 4^{thly}, A *Scotia* of four Minutes three Fourths. 5^{thly}, Another *List*, or *Cincture*, of one Minute one Fourth. 6^{thly}, A *Thorus* of five Minutes one Fourth. All which, being added together, make up thirty Minutes, which compleats the Base.

Above the *Base*, on the Foot of the Body of the Column, he places an *Astragal* of two Minutes one Fourth; and above that a *Cincture* of one Minute one Fourth: All which together make thirty-three Minutes and a half.

Scamozzi also makes the *Ionic Base* thirty Minutes in Height, and

and consisting of the same Number of Parts and Form with that of *Palladio*, viz. 1st, A *Plinth* (which is concave) of ten Minutes and a half. 2^{dly}, A *Thorus* of eight Minutes. 3^{dly}, A *List* of one Minute. 4^{thly}, A *Scotia* of four Minutes and a half. 5^{thly}, A *List* of one Min. And, 6^{thly}, another *Thorus* of five Min. All which, added together, make the Base thirty Minutes.

Above which, on the Column, are two small Members more, viz. an *Astragal* of two Minutes and a half, and a *List* of one Minute and a half: All which together make the Height thirty-four Minutes.

Vignola composes his *Ionic Base* of the same Number of small Members, and of the same Form with that of *Vitruvius*.

The *Corinthian Base*, according to *Vitruvius*, is half a Mod. in Height, both in the *Corinthian Column* with a Pedestal, and that without a Pedestal; both of which he makes to consist of four finaler Members, viz. 1st, A *Plinth*. 2^{dly}, Two *Thorus's*. 3^{dly}, Four *Filletts*. 4^{thly}, Two *Scotia's*, and two *Astragals*.

This Base he divides thus: First, he divides the whole Height into four equal Parts; the lower of which Divisions he assigns for the *Plinth*; the three remaining Parts are again subdivided into five equal Parts, the upper of which five is assigned to the upper *Thorus*, (which is the highest Member of the Base;) the lower *Thorus* is made to contain five Quarters of one of these fifth Parts, viz. all the first, or lower fifth Part, and half of the second; so that one Fifth being taken from the upper

Thorus, and the one Fifth and one Fourth of the one Fifth below for the lower *Thorus*, there remains but two of these Fifths, three of one Fifth, of which he subdivides into twelve equal Parts.

Of half the lower Twelfth, he makes the 1st, (or lowest *Fillet*;) then of the other half, all the 2^d, 3^d, 4th; and half the 5th, he makes the lower *Scotia*; of the remaining half of the fifth twelfth Part, he makes the second *Fillet*; of the 6th and 7th Parts, he makes the two *Astragals*; of half the 8th, he makes the third *Fillet*; of the other half of the 8th, and all the 9th, 10th, and 11th, and half the 12th, he makes the second *Scotia*; and of the last half of the twelfth Part, he makes the fourth or last *Fillet* which subjoins the under Side of the upper *Thorus*.

He also adds a *Fillet* above the Base, which is one Twenty-fourth of the Diameter of the Column in Altitude, which is 24 Minutes and a half.

The Base of the *Corinthian Column* with its Pedestal, is of the same Altitude and Number of Parts; and each Part has the same Dimensions with that which has no Pedestal.

Palladio makes this Base to contain eight smaller Members, viz. one *Orlo*, two *Thorus's*, two *Astragals*, two *Cinctures*, and one *Scotia*; (though probably the Author, or Engraver, has made some Mistake in the Division and Subdivision of the Base; but I shall give it as it is there found.)

He makes the *Orlo* nine Minutes two Thirds; the lower *Thorus* seven Minutes; the lower *Astragal* three Fourths of a Minute

Minute, (which seems to be too little;) the lower *Cincture* one Fourth of a Minute; the *Scotia* three Minutes three Fourths; the next *Cincture* has not any Number set to it, but it appears of the same Size with the other *Cincture*: Then comes the next *Astragal* of half a Minute, and then the upper *Thorus* of five Minutes; and he places another *Astragal* of two Minutes and a half above these eight Members of the *Base*, and another *Astragal* of two Minutes and a half, and a *Cincture* above that.

This, it is true, is but a lame Account; but the Fault lies either in the Author, or Engraver, or both.

Scamozzi portrays this *Base* of thirty Minutes in Altitude, and divides this grand Member into eight petty ones, of the same Form with those of *Palladio*, viz. 1st, An *Orlo* of nine Minutes and a half. 2^{dly}, A *Thorus* of seven Minutes. 3^{dly}, An *Astragal* of two Minutes. 4^{thly}, A *List* of one Minute. 5^{thly}, A *Scotia* of three Minutes and a half. 6^{thly}, A *List* of one Minute. 7^{thly}, Another *Astragal* of one Minute and a half. And 8^{thly}, and last of all, a *Thorus* of four Minutes and a half: All which, added together, make up thirty Minutes.

He also places above the *Base* two other Members on the Foot of the Column, viz. an *Astragal* of two Minutes and a half, and a *List* of one Minute.

Vignola allows thirty Minutes to the Altitude of this *Base*; and as to the Form, he makes it the same with that of *Vitruvius*.

The *Composite* or *Roman Base*, according to *Vitruvius*, contains thirty Minutes in Height.

This grand Member he divides into ten smaller, viz. a *Plinth*, two *Thorus's*, (one of which is in the Middle, where the two *Astragals* are in the *Corinthian Order*,) four *Fillets*, and two *Scotia's*.

He first divides this Member into four Parts, the lower of which is for the Altitude of the *Plinth*; and then he subdivides the other three Parts into five. Of the uppermost of the five, he makes the upper *Thorus*; of the lower Fifth, and one Fourth of the second, he makes the lower *Thorus*; (so that the lower *Thorus* is four Fifths high:) The second fifth Part and three Fourths that remain, he subdivides into twelve equal Parts; of half the lower twelfth, he makes the first *Fillet*; of the other Half, and all the 2^d, 3^d, 4th, and half the 5th, he makes the first *Scotia*; of the remaining Half of the 5th, he makes the second *Fillet*; of the 6th and 7th, he makes the middle *Thorus*; of half the 8th, he makes the third *Fillet*; of the remaining Half of the 8th, and all the 9th, 10th, and 11th, and half the 12th, he makes the second *Scotia*; of the remaining Half of the 12th, he makes the last *Fillet*, which is just under the upper *Thorus*.

Above the *Base*, on the Foot of the Column, he makes a *Fillet*, which is one twenty-fourth of the Diameter of the Column below.

Palladio makes this *Base* thirty Minutes in Altitude, and divides it into eleven small Members, viz. an *Orlo*, two *Thorus's*, four *Lists*, two *Scotia's*, and two *Astragals*.

To the first Member, being an *Orlo*, (which is concave) he allows nine Minutes ; next to that are the two *Thorus's*, which are seven Minutes ; then a *List* of half a Minute ; after that a *Scotia* of three Minutes ; then another *List* of one half of a Minute ; after that the two *Astragals*, of one Minute each ; then a *Fillet*, or *List*, of half a Minute ; and next the upper *Thorus* of four Minutes.

Above this, on the Foot of the *Column*, he places another *Astragal* of three Minutes ; and also a *List* of one Minute above that.

Scamozzi allows thirty Minutes for the Altitude of the *Roman Base*, and divides these into seven smaller Members, allowing ten Minutes to a concave *Plinth*, and seven Minutes to the first *Thorus* ; two Minutes to an *Astragal* ; and to the first *List* one Minute ; to the *Scotia* four Minutes ; and the second *List* one Minute, and to the upper *Thorus* five Minutes, which is the highest Member of the Base.

But he places two Members above the *Base*, viz. an *Astragal* of two Minutes and a half, and a *List* of one Minute one Fourth.

Vignola makes his *Roman Base* very much like that of *Vitruvius* ; except, that he places two *Astragals* in the Middle between the two *Scotia's*, where *Vitruvius* places a *Thorus*.

M. *Le Clerc* says, all the Parts of the Base of a Column ought to be plain, in order to serve as a Rest to the Flutings of the Shaft.

However, he says, there are some Occasions wherein the *Tho-*

rus may be enrich'd ; of which we have an Instance in the new Chapel at *Versailles*, where 'tis done with a great deal of Prudence.

For as nothing should be exposed to the Eyes of a great Prince, but what is some Ways distinguish'd by its Richness ; and as the King here has in Sight the Bases of the Columns of his Seat, 'tis but just they should be enrich'd like the rest of the Chapel, which is extremely pompous : But, setting aside such Occasions, it would be a Fault to adorn the Bases of Columns ; though *Scamozzi* is of another Opinion.

A *Base of any solid Figure*, is its lowermost plain Side, or that on which it stands ; and if the Solid has two opposite parallel plain Sides, one of them is the *Base* ; and then the other is also called its *Base*.

BASIL, with *Joiners*, &c. the Angle to which the Edge of an Iron Tool is ground. To work on soft Wood, they usually make their *Basil* twelve Degrees ; for hard eighteen Degrees ; it being observ'd, that the more acute or thin the *Basil* is, the better and smooother it cuts ; and the more obtuse, the stronger and fitter for Service.

BASILIC [of *Basilium*, Gr. BASILICA] a Royal House or Palace] a Term anciently used for a large Hall, or publick Place, with Isles, Portico's, Galleries, Tribunals, &c. where Princes sat and administred Justice in Person.

But the Name has since been transferred, and is now applied to such Churches, Temples, &c. which, by their Grandeur, as far surpass other Churches, as Princes

ces Palaces do private Houses. As also, to certain spacious Halls in Princes Courts, where the People hold their Assemblies. And also such stately Buildings where Merchants meet and converse together : As for Instance, that of the Palace at *Paris*, the *Royal Exchange* in *London*, &c.

BASON, a Reservatory of Water, as the Bason of a *Fet d'Eau*, or Fountain ; the Bason of a Port, *Bath*, &c. which *Vitruius* calls *Labrum*.

BASSO RELIEVO, } is a

BASS-RELIEF, } Piece of Sculpture, the Figures of which do not project far, or stand out from the Ground in their full Proportion. *M. Felibien* distinguishes three Kinds of *Basso-Relievo's* : In the first, the front Figures appears almost with the full *Relievo* ; in the second, they stand out no more than one Half ; and in the third, much less, as in Coins, Vases, &c.

BATEMENT, a Term in Carpentry, signifying an Abatement or Waste of a Piece of Stuff, by forming it to a design'd Purpose or Use : Thus instead of asking how much was cut off from such a Board or Piece of Stuff, they say, what Batement had that Piece of Stuff ?

BATTEN, is a Name that Workmen give to a Scantling of Wooden Stuff, from two to four Inches broad, and about one Inch thick ; the Length is pretty considerable, but undetermined.

This Term is chiefly used in speaking of Doors, and Windows of Shops, &c. which are not fram'd of Whole Deat, or one quarter Inch-Oak, with

Stiles, *Rails*, and *Pannels*, (as Wainscot is fram'd ; and yet they are made to appear as if they were, by Means of these Pieces or *Battens*, bradded on upon the plain Boards which are joined together for the Door, or Window, all round, and sometimes cross them, and up and down, &c. according to the Number of the Pannels, the Workman designs the Door or Window shall appear to have.

These Pieces, which are thus bradded on, to represent *Stiles*, *Rails*, and *Mountans*, and are of different Breadths, according to the Design of the Workmen, as from two to six or seven Inches ; and there is usually some Moulding struck, as a *Bead*, an *Ogee*, or the like, on one Edge of those that represent the *Stiles*, and the upper and lower *Rails*, and on both the Edges of those which are design'd to appear like *Mountans*, and middle *Rails*.

BATTEN-DOORS are such as seem to be Wainscot ones, but are not ; for in Wainscot ones, the *Pannels* are groov'd into the Framing ; but in these, they first joint and glew the Boards, which are cut to the full Length and Breadth of the Door-Case ; which Glewing being dry, they traverse them over with a long Plane ; and being smooth'd, the *Battens* are fitted on, on the Front-Side. And these are called single *Batten-Doors* ; for there are others call'd double *Batten-Doors*. viz. such as are battened on both ; though this is but rarely done.

But there are battened Doors, which are called double Doors, such as Front or Outer-Doors ; which are usually made of whole Deal,

Deal, and afterwards batten'd on the Outside, and Pieces four or five Inches broad mitred round the Edges on the Inside of the Door; and then it is lin'd cross the Door betwixt these Pieces, with thin Slit-Deal, which renders it level with the mitred Pieces.

Some Doors have been lin'd with Pieces laid Bevelling, and not at Right Angles, but near Mitre to the Sides of the Door; and when all has been plain'd off level, it has been divided into Rhombus's, and struck with a Pencil, and round-headed Nails driven in at the Angles of the Rhombus's, which added something of Beauty to the Work.

This Way of Lining upon the Doors, *viz.* pointing from the lower Corner behind, towards the upper Corner before, seems to be a good Way to prevent a Door from sagging or sinking at the Fore-Corner, whenever the Joints shall happen to unglew.

As to the Price of Batten-Doors: For the Workmanship of making Batten-Doors of Slit-Deal, about an Inch in Thickness (or of thin Whole Deals,) glew'd and batten'd on one Side, 4*s.* *per* Door, is a moderate Price between Master and Workman: But for such as have been mention'd above (which are for Front and other Outer Doors, *viz.* both batten'd and lin'd are worth 7*s.* *per* Door, for Workmanship.

BATTER, a Term used by Bricklayers, Carpenters, &c. to signify that a Wall, Piece of Timber, or the like, doth not stand upright, but leans from you-ward, when you stand before it; but when on the contrary, it leans toward you, they say it *overhangs*, or *hangs over*.

BATTLEMENTS, are Indentures or Notches in the Top of a Wall, or other Building, in the Form of Embrasures, for the sake of looking through them, &c.

BAY, a Term used to signify the Magnitude of a *Barn*; as if a Barn consists of a Floor and two Heads, where they lay Corn, they call it a Barn of two *Bays*.

These *Bays* are from fourteen to twenty Foot long, and Floors, from ten (which is the smallest Size) to twelve broad, and usually twenty Foot long, which is the Breadth of the Barn.

If a *Bay* be twenty Foot in Length; then there is usually a Pair of *Prick-Posts* in the Middle, and a *Beam* to hold in the Rod from bending the *Raisons*; but if the *Bays* are not more than sixteen Foot, and the Timber stout, then there are no Posts; but at the End of each Bay, where there are always hanging Braces, fram'd into the *Beam* and *Posts*; and also a Cross-Cell, to hold in the Side-Cells from flying out when the Barn is full: And also 'tis common for large Barns to consist of divers *Bays*.

BAY-WINDOW, one that is composed of an Arch of a Circle; and consequently such a one will stand without the Strefs of the Building. By which Means Spectators may better see what is done in the Street.

BEACON, a Signal for the better Security of the Kingdom from Foreign Invasions. These are long Poles or Posts set up on certain Eminencies, on which are fasten'd Pitch-Barrels, to be fir'd by Night, and Smoke made by Day, to give Notice to the whole

whole Kingdom, in a few Hours of an approaching Invasion.

BEAD [in *Architecture*] a round Moulding, commonly made upon the Edge of a Piece of Stuff, in the *Corinthian* and *Roman* Orders, cut or carv'd in short Embossments, like Beads in Necklaces, in Semi-Relief. See **BAGUETTE**.

A *Bead* is usually one quarter of a Circle, and only differs from a *Boultin* in Size: For when they are large, Workmen commonly call them *Boultins*. Sometimes a *Bead-Plain* is set on the Edge of each *Fascia* of an Architecture, and sometimes likewise an *Astragal* is thus carv'd: In both which these Carvings are called *Beads*.

A *Bead* is often placed on the Lining-Board of a Door-Case, and on the upper Edges of Skirting-Boards.

BEAK [in *Architecture*] a little Fillet, left on the Edge of a *Larmier*, which forms a Canal, and makes a kind of Pendant.

Chin-Beak, a Moulding, the same as the Quarter-round, except that its Situation is inverted. This is very frequent in modern Buildings, though few Examples of it are found in the Ancient.

BEAM, in a Building, is the largest Piece of Wood in a Building, which always lies cross the Building or the Walls, and serving to support the principal Rafter of the Roof, and into which the Feet of the principal Rafter are fram'd.

No Building has less than two of these Beams, viz. one at each Head. Into these, the Girders

of the Garret-Floor are also fram'd; and if the Building be of Timber, the *Teazle-Tenons* of the Posts are fram'd.

The *Teazle-Tenons* are made at Right Angles to those which are made on the Posts to go into the *Raisons*; and the *Relish* or *Cheats* of these *Teazle-Tenons*, stand up within an Inch and half of the Top of the *Raison*, and the Beam is *cauked* down (which is the same Thing as Dove-tailing across) till the Checks of the Mortises in the Beam conjoin with those of the *Teazle-Tenons* on the Posts.

As to the Size of Beams. The Proportions of Beams in or near *London*, are fix'd by a Statute or Act of Parliament for the rebuilding of the City of *London*, after the Fire in 1666, and were appointed to be of the following Scantlings.

A Beam fifteen Foot long, must be seven Inches on one Side its Square, and five on the other; if it be sixteen Foot long one Side must be eight Inches, the other six: If seventeen Foot long, one Side must be ten Inches, and the other six; and so proportionable to their Lengths. In the Country, where Wood is more plenty, they usually make their Beams stronger.

Sir *Henry Wotton* advises, That all *Beams*, *Summers*, and *Girders*, be made of the strongest and most durable Timber.

Herrera informs us, That in *Ferdinand Cortez's* Palace in *Mexico*, there were seven thousand Beams of Cedar: But then he must be understood to use the Word *Beam* in a greater Latitude than it is used with us. The *French*,

French, under the Word *Poutre*, which signifies a Beam, take in not only the Pieces which bear the Rafters, but also all those which sustain the Joists for the Ceilings

Some *French* Authors have consider'd the Force of *Beams*, and brought their Resistance to a precise Calculation; as particularly, M. *Varignon*, and M. *Parent*: The System of the latter of which, is as follows:

When two Plans of Fibres, which were contiguous before, are separated in a *Beam*, which breaks parallel to its Base, (which is suppos'd to be a Parallelogram,) there is nothing to be consider'd in these Fibres, but their Number, Bigness, and Tension, before they are broken; and the Lever, by which they act: All these together making the Resistance of the Beam remaining to be broke.

Then suppose another *Beam* of the same Wood, where the Base is likewise a Parallelogram, and of any Bigness, with regard to the other, at Pleasure. The Height of each of these, when laid Horizontal, being divided into an indefinite Number of equal Parts, and their Breadth into the same Number, in each of their Bases will be found an equal Number of small quadrangular Cells, proportional to the Bases of which they are Parts; then these will represent little Bases; or, which is the same Thing, the Thicknesses of the Fibres to be separated for the Fracture of each Beam, and the Number of Cells being equal in each *Beam*, the Ratio of the Bases of both *Beams* will be that of

the Resistance of their Fibres, both as to Number and Thickness.

Now the two *Beams* being supposed to be of the same Wood, the Fibres most remote from the Points of Support, which are those which break the first, must be equally stretch'd when they break.

Thus the Fibres, *v. g.* of the tenth Division, are equally stretch'd in each Case, when the first breaks; and in whatever Proportion the Tension be supposed, it will be still the same in both Cases; so that the Doctrine be entirely free, and unemparas'd with any System of Physicks.

Lastly, It is evident, that the *Levers*, by which the Fibres of the two *Beams* act, are represented by the Height of their Bases; and consequently the whole Resistance of each *Beam* is the Product of its Base by its Height; or, which is the same Thing, the Square of the Height being multiply'd by the Breadth, which holds not only of parallelogrammick, but also of Elliptical Bases.

Hence, if the Basis of two *Beams* be equal, though both their Heights be unequal, their Resistance will be as their Heights alone; and consequently one and the same *Beam* laid on the smallest Side of its Base, will resist more than when laid flat, in Proportion, as the first Situation gives it a greater Height than the second. And thus an Elliptical Base will resist more, when laid on its greatest Axis, than on its smallest.

Since in *Beams* equal in Length, it is the Bases which determine

the Proportion of their Weights or Solidities; and since their Bases being equal, their Heights may be different, two *Beams* of the same Weight may have Resistance different to Infinity. Thus, if in the one the Height of the Base be conceived infinitely great, and the Breadth infinitely small; while in the other, the Dimensions of the Base are finite, the Resistance of the first will be infinitely greater than that of the second, though their Solidity and Weight be the same.

If therefore, all requir'd in Architecture were to have *Beams* capable of supporting vast Loads, and at the same Time have the least Weights possible, 'tis plain they must be cut thin as Laths, and laid edge-wise.

If the Bases of the two *Beams* are supposed to be unequal, but the Sum of the Sides of the two Bases equal, *v. g.* if they be either 12 and 12, or 11 and 13, or 10 and 14, &c. so that they always make 24; and further, if they are supposed to be laid edge-wise, pursuing the Series, it will appear, that in the *Beam* of 12 and 12, the Resistance will be 1728, and the Solidity or Weight 144, or that in the last, or 1 and 23, the Resistance will be 529, and the Weight 23: Therefore the first, which is square, will half the Strength of the last with Regard to its Weight.

Hence M. *Parent* remarks, that the common Practice of cutting the Beams out of Trees as square as possible, is ill Husbandry: And thence he takes Occasion to determine Geome-

trically, what Dimensions the Base of a Beam to be cut out of any Tree proposed should have, in order to its having the greatest Resistance possible; or which is the same Thing, a Circular Base being given, he determines the Rectangle of the greatest Resistance that can be inscrib'd, and finds that the Sides must be nearly as 7 to 5; which agrees with Observation.

Hitherto we have supposed the Length of the *Beams* to be equal; if it be unequal, the Bases will resist so much the less, as the *Beams* are the longer.

To this it may be added, That a *Beam* sustained at each End, breaking by a Weight suspended from its Middle, does not only break at the Middle, but at each Extreme; or if it does not actually break there, at least, immediately before the Moment of the Fracture, which is that of the *Æquilibrium* between the Resistance and the Weight, its Fibres are as much stretch'd at the Extremes, as in the Middle; so that of the Weight sustain'd by the Middle, there is but one third Part that acts at the Middle to make the Fracture; the other two only acting to induce a Fracture in the two Extremes.

A *Beam* may be supposed to be either loaden only with its own Weight, or with other foreign Weights, apply'd at any Distance, or only with those foreign Weights. Since, according to M. *Parent*, the Weight of a *Beam* is not ordinarily above one seventieth Part of the Load given to sustain it, it is evident, that in considering several Weights

they must be all reduced by the common Rules, to one common Centre of Gravity.

M. *Parent* has also calculated Tables of the Weights, which will be sustain'd by the Middle in *Beams* of various Bases and Lengths, fitted at each End; into Walls, on a Supposition, that a Piece of Oak of an Inch square, and a Foot long, retain'd horizontally by the two Extrems, will sustain three hundred and fifteen Pounds in its Middle, before it breaks; which it has been found by Experiments, that it will. See *The Memoirs of the French Academy*, Anno 1708.

BEAM-COMPASSSES, an Instrument made either of Wood or Brass, with sliding Sockets or or Cursors, which serve to carry several shifting Points for drawing and dividing Circles with very long Radii.

They are of Use in large Projections, for drawing the Furnitures on Wall-Dials, &c.

BEAM-FILLING, in Building, is Plasterer's Work, and is the Filling up the vacant Space between the Raïson and Roof, whether Tiling, Thatching, or any other Roof, with Stones or Bricks laid between the Rafters on the Raïson, and plaistered on with Loam, frequent where the Garrets are not pargeted or plaister'd; or sometimes they set some Tiles with one Edge upon the Raïson, and the other leaning against the Roof; and then these Tiles are plaister'd over with Loam. This Sort of Work is very common in the Country, where they do not parget or plaister their Garrets.

The Price: The usual Price

for Workmanship only, in the Country, is a Halfpenny per Foot, or three Halfpence per Yard lineal Measure.

To BEAR *Timber*, is said to bear at its whole Length, when neither a Brick-Wall, or Posts, &c. stand between the Ends of it; but if either a Brick-Wall or Posts be trimm'd up to the Timber, then it is said to bear only at the Distance between the Brick-Wall, or Post, and either End of the Timber.

Thus Carpenters usually ask, What *Bearing* such a Piece of Timber has? The Answer to such a Question, is ten, fifteen, or twenty Foot, &c. according to the Length of the whole Timber; or else according to the Distance between either End of the Timber.

BEARER, in Architecture, a Post or Brick-Wall trimmed up between the two Ends of a Piece of Timber, to shorten its Bearing; or to prevent its bearing with the whole Weight at the Ends only.

BEARING of a Piece of Timber, with Carpenters, the Space, either between the two fixed Extrems thereof, when it has no other Support, which they call *Bearing at Length*; or between one Extream and a Post, Brick-Wall, &c. trimm'd up between the Ends, to shorten its *Bearing*.

BED of STONE, in Masonry, a Course or Range of Stones; and the Joint of the *Bed* is the Mortar between two Stones, placed over each other.

BED-MOULDING, }
BEDDING-MOULDING, }

a Term used by Workmen to signify those Members in a Cornice which are placed below the

Coronet: And now, a *Bed-Moulding*, with Joiners, usually consists of these four Members, an *Ogee*, a *Lift*, a large *Boulton*, and another *Lift* under the Coronet.

BEVEL, $\angle$ [in *Masonry* and BEVIL, $\angle$ *Joinery*] a kind of Square, one Leg of which is frequently crooked, according to the Sweep of an Arch or Vault. It is moveable on a Point or Centre, and so may be set to any Angle. The Make and Use of it are pretty much the same as those of the common Square and Mitre, except that those are fixed; the first at an Angle of ninety Degrees, and the second at forty-five: Whereas the Bevel being moveable, it may in some Measure supply the Office of both, and yet supply the Deficiency of both, which it is chiefly intended for, serving to set off or transfer Angles, either greater or less than ninety or forty-five Degrees. Hence,

Any Angle that is not square, is called a Bevel-Angle, whether it be more obtuse, or more acute, than a Right Angle: But if it be one half as much as a Right Angle, viz. forty-five Degrees, then Workmen call it *Miter*. They have also a Term *Half-Miter*, which is an Angle that is one quarter of a Quadrant or Square, viz. an Angle of twenty-two Degrees and a half. This they call a *Half-Miter*.

GREEN BICE, is a Colour of a sandy Nature, and therefore not much used. But it is to be wash'd before it be used. See *WASHING of Colours*.

Blue Bice bears the best Body of all bright *Blues* us'd in common Work, but 'tis the palest in Colour; it works indifferently well, but inclines a little to be sandy; therefore it requires good Grinding, and that on a very hard Stone. It is a Blue that lies best near the Eye of any now in Use, except *Ultramarine*, a Colour produced from the Tincture of *Lapis Lazuli*; but this is so very dear, that it is not to be used but in Pieces of great Price. This *Bice* is also to be wash'd. See *WASHING of Colours*.

BILL, an Edg'd Tool fitted to a Handle, used in lopping Trees. When it is long, it is called a *Hedging-Bill*; when short, a *Hand-Bill*.

BINDING - JOISTS, are those Joists in any Floor, into which the Trimmers of Stair-Cases (or Well-Holes for the Stairs) and Chimney-Ways are fram'd. These Joists ought to be stronger than common Joists.

As to the Scantling and Size of these, as well as all other Timber Members, it was settled by an Act of Parliament before the Rebuilding of London; according to which Act, *Binding-Joists* which contain in Length

Feet.			Inches.		Inches.
7	}}	must be in their Squares,	6	}	and 5.
9			7		
11, or 12			8		

So large they were ordered to be, and not less; but probably, they might be as much bigger as they pleased.

BISSECTION, in Geometry, the Division of any Quantity into two equal Parts; and is the same with **Bi**partition. Thus to bissect any Line, is to divide it into two equal Parts.

BLACKS, used in Painting, as **LAMP-BLACK**: This Colour is nothing but a Soot raised from the Rosiny and fat Parts of Fir-Trees. It comes to us mostly from the Northern Countries, as *Sweden* and *Norway*. This *Black* is more generally used in Painting than any other, because of its Plenty and Cheapness; and proves a very good *Black* for most Uses: 'Tis of so fine a Body, that if only temper'd with Lin-Seed Oil, it will serve to work with on most common Occasions, without grinding.

But being thus used, it will require a long Time to dry, unless there be a good deal of drying Oil mixed with it; or, which is better, some Verdegrease finely ground: This, and the drying Oil together, will make it dry quickly. Also some add Oil of Turpentine, which gives it also a drying Quality; but without some of these, it will be a long Time a drying: For in the Substance of the Colour is contained a greasy Fatness, that is an Enemy to Drying. To remedy which, if it be burnt in the Fire, till it be red-hot, and cease to smoke, the Fatness will be consumed, and then it will dry much sooner. But when it is burnt, it must then of Necessity be ground with Oil, the Fire being of that

Nature, that it is apt to harden most Bodies that pass through it.

This Colour is usually made up in small Barrels, &c. of Deal of several Sizes, and is so brought over to us.

Lamp-Black is burnt, or rather dry'd in the following Manner:

It is put into an Iron Ladle, or a Crucible, and set over a clear Fire, and there let it remain till it be red-hot, or so near it, that there is no manner of Smoke arises from it.

Besides this *Black*, there is another Sort of *Black*, which is the Soot of a Lamp; which some commend as a much better *Black* for any Use than the former, it being of a finer Body, and brighter Colour. But this not being to be procured in very great Quantities, is therefore only used in very fine Work.

Ivory-Black is made of Comb-Makers Raspings, and other waste Fragments of Ivory; being burnt or charr'd to a black Coal in a Crucible close stopp'd up; which proves a very delicate *Black*, when ground very fine. It is sold at Colour-Shops, well prepar'd and levigated, or ground very fine with Water on a Marble-Stone, and then dry'd in small Lumps: Being thus prepar'd 'tis the more easily ground in Oil, with which it will lie with as smooth a Body as most Colours do; but being pretty dear, is therefore not used in any common Work.

Some use Willow-Charcoal, This, if ground very fine in Oil, makes a very good *Black*; but is not so much used as the *Lamp-Black*, not being so easily to be gotten.

B O

Ivory must be burnt also to make a *Black*, thus: Fill two Crucibles with Ivory Shavings, then clap their two Mouths together, and bind them fast with an Iron Wire, and lute the Joints close with Clay, Salt, and Horse-Dung, well beaten together; then set it in a Fire, covering it all over with Coals, and let it remain therein, till you are sure the Matter inclosed in the Crucibles be thoroughly red-hot; then take it from the Fire, but open not the Crucibles till they are perfectly cold; for if you should open them while hot, the Matter would turn to Ashes. The same will be done, if the Joints are not luted close; for 'tis only the Exclusion of all Air, that prevents any Matter whatever that's burnt to a Coal, from turning to a white Ash, and preserves the Blackness.

BLOCK of Marble, a Piece of Marble, as it comes out of the Quarry, before it has assum'd any Form from the Hand of a Workman.

BOARD-MEASURE. To measure a Board, is nothing else but the measuring along Square.

EXAMPLE.

If a *Board* be sixteen Inches broad, and thirteen Feet long, how many Feet are contained therein?

Multiply sixteen by thirteen, and the Product will be two hundred and eight; which being divided by twelve, gives seventeen Feet, and four remaining, which is a third Part of a Foot, thus:

B L

$$\begin{array}{r}
 12 : 13 :: 16 \\
 \quad \quad 13 \\
 \quad \quad \hline
 \quad \quad 48 \\
 \quad \quad 16 \\
 \quad \quad \hline
 12)208(17 \frac{4}{12} \\
 \quad \quad 12 \\
 \quad \quad \hline
 \quad \quad 88 \\
 \quad \quad 84 \\
 \quad \quad \hline
 \quad \quad 4
 \end{array}$$

Or you may multiply one hundred and fifty-six (the Length in Inches) by sixteen, and the Product will be two thousand four hundred and ninety-six; which being divided by one hundred and forty-four (the Number of Inches in a Foot square,) the Quotient will be seventeen Feet, and forty-eight remaining, which is a third Part of one hundred and forty-four, as before, thus:

$$\begin{array}{r}
 144 : 156 :: 16 \\
 \quad \quad 16 \\
 \quad \quad \hline
 \quad \quad 936 \\
 \quad \quad 156 \\
 \quad \quad \hline
 144)2496(17 \frac{48}{144} \\
 \quad \quad 144 \\
 \quad \quad \hline
 \quad \quad 1056 \\
 \quad \quad 1008 \\
 \quad \quad \hline
 \quad \quad 48
 \end{array}$$

By Scale and Compasses.

Extend the Compasses from twelve to thirteen; the same Extent will reach from sixteen to seventeen

seventeen Feet and one Third, the Content. Or,

Extend them from one hundred forty-four to one hundred fifty-six, (the Length in Inches;) and the same Extent will reach from sixteen to seventeen Feet one Third, the Content.

Example II. If a Board be nineteen Inches broad, how many Inches in Length will make a Foot?

Divide one hundred and forty-four by nineteen, and the Quotient will be seven very near; and so many in Length, if a Board be nineteen Inches broad, will make a Foot.

Inc. Inc. Inc. Inc.

19 : 144 : 1 : 7. 11. or 58 fere.

$$\begin{array}{r} 133 \\ \hline 11 \end{array} \quad 19$$

Again; Extend the Compasses from nineteen to one hundred forty-four; that Extent will reach from one to seven, fifty-eight, *i. e.* seven Inches and somewhat more than a half; so that if a Board be nineteen Inches broad, if you take seven Inches, and a little more than a half in your Compasses, from a Scale of Inches, and run that Extent along the Board from End to End, you may find how many Feet that Board contains, or you may cut off from that Board any Number of Feet desired.

For this Purpose there is a Line upon most ordinary Joint-Rules, with a little Table placed upon the End, of all such Numbers as exceed the Length of the Rule, as in this little Table annexed.

0	0	0	0	5	0	8	6
12	6	4	3	2	2	1½	1
1	2	3	4	5	6	7	8

Here you see if the Breadth be one Inch, the Length must be twelve Feet; if two Inches, the Length is six Feet; if five Inches broad, the Length is two Feet five Inches, &c.

The rest of the Lengths are express'd in the Line thus: If the Breadth be nine Inches, you will find it against sixteen Inches, counted from the other End of the Rule; if the Breadth be eleven Inches, then a little above thirteen Inches will be the Length of a Foot, &c.

BOARDING of Wall. See *Weather Boarding*.

BOATNAILS, a certain Sort of Nails.

BODY [in *Geometry*] is that which has three Dimensions, Length, Breadth, and Thickness. As a Line is form'd by the Motion of a Point, and a Superficies by the Motion of a Line, so a Body is general by the Motion of a Superficies.

To BEAR A BODY [with *Painters*.] A Colour is said to bear a Body, when it is of such a Nature, as is capable of being ground so fine, and mixing with the Oil so intirely, as to seem only a very thick Oil of the same Colour; and of this Nature are *White-Lead* and *Ceruse*, *Lamp-Black*, *Vermillion*, *Lake*, *Pink*, *Yellow Oker*, *Verdegreafe*, *Indigo*, *Umber*, and *Spanish Brown*; *Blue Bice* and *Red-Lead* are not so fine; but yet so fine, that they may be said to bear a very good Body. All these may be ground so fine, as to be even like Oil itself;

self; and then they also may be said to work well, spreading so smooth, and covering the Body of what you lay upon it so entirely, as that no Part will remain visible where the Pencil hath gone, if the Colour be work'd stiff enough.

Whereas, on the contrary, Verditer and Smalts, with all the grinding imaginable, will never be well imbodied with the Oil, nor work well: Indeed Bice and Red-Lead will hardly grind to an oily Firmness, nor lie entirely smooth in the working; yet may be said to *bear an indifferent Body*, because they will cover such Work very well, that they are laid upon; but such Colours as are said not to *bear a Body*, will readily part with the Oil, when laid on the Work; so that when the Colour shall be laid on a Piece of Work, there will be a Separation, the Colour in some Parts, and the clear Oil in others, except they are temper'd extreme thick.

BOLTS of Iron, for House-Building, are distinguish'd by Iron-Mongers into three Kinds, *viz.* *Plate, Round, and Spring Bolts*; *Plate* and *Spring Bolts* are used for the fastening Doors and Windows, and these are of different Sizes and Prices: Small *Spring Bolts* have been sold for three Pence Half-penny *per Piece*, others at nine Pence, others at fourteen Pence; and so likewise *Plate Bolts* some nine Pence, and some ten Pence.

There are also *Brass-knob'd Bolts*, short and long; the short are sold for about ten Pence *per Piece*; and long for Folding-Doors, at eighteen Pence *per*

Piece; and Iron *Balcony Bolts* at about ten Pence *per Piece*; and *Round Bolts*, (or long Iron Pins,) with a Head at one End, and a Key-Hole at the other, which are usually sold by the Pound, *viz.* three Pence Half-penny or four Pence *per Pound*.

BOND, a Term among Workmen, as make *good Bond*, means that they should fasten the two or more Pieces together, either by tenanting, mortising or dovetailing, &c.

BOSSAGE } in *Architecture*,
BOSCAGE } is a Term used for any Stone that has a Projection, and is laid in a Place in a Building Lineal, to be afterwards carved into Mouldings, Capitals, Coats of Arms, &c.

Bossage is also that which is otherwise called *Rustick Work*; which consists of Stones which seem to advance beyond the Naked of a Building, by reason of Indentures or Channels left in the Joinings: These are chiefly used in the Corners of Edifices, and thence called *Rustick Quoins*.

The Cavities or Indentures are sometimes round, and sometimes chain-fram'd, or bevell'd; sometimes in a Diamond Form, and sometimes it is inclos'd with a Cavetto, and sometimes with a Listel.

BOTHAM NAILS, a sort of *Nails* so called by Ironmongers.

BOULDER WALLS, a kind of *Walls* built of round Flints or Pebbles, laid in a strong Mortar; used where the Sea has a Beach cast up, or where there are plenty of Flints.

As to the Manner of building these *Walls*, a Bricklayer, which has been used to this kind of Work,

Work, *says*, that in this Work they always use a very strong stiff Mortar ; and that if they can so order it, they always work two at it at a time, one at one Side of the *Wall*, and the other at the other ; and one to the Right Hand and the other to the Left ; and that therefore it is best if one of the Workmen be left-handed : That they have a Hod of Mortar poured down on their Work, and so they spread it betwixt them, each spreading it towards his own Side, and then lay their *Boulders* or *Flints*. He adds, that they had need have a good Length of Work before them, for they work but one Course in Height at a Time ; for if they should do more, it would be apt to swell out at the Sides, and run down ; and for that Reason are obliged to work continually lengthways. And that if this Work be done in misty Weather, it is very difficult to make it stand.

As to the Price of this Work : It is commonly done by the Square, or hundred Foot, for which their usual Price is twelve Shillings for Workmanship only.

BOULTINE, a Term which Workmen use for a Moulding, whose Convexity is just one Fourth of a Circle ; being the Member next below the Plinth in the *Tuscan* and *Doric* Capital. See **QUARTER ROUND**.

BRACE, in a Building, a Piece of Timber fram'd with bevel Joints. Its Use is to keep the Building from swerving either Way. When *Braces* are fram'd into King-Pieces, or principal Rafter, they are called *Struts*.

BRADS, a kind of Nails used in Building, which have no spreading Heads, as other Nails have. These are distinguished by Ironmongers by six Names, as *Joiners Brads*, *Flooring Brads*, *Batten Brads*, *Bill Brads*, or *Quarter Heads*, &c.

Joiners Brads, for hard Wood-Wainscot, from one Inch to two and a quarter in Length.

Batten Brads, for soft Wood-Wainscot, these sorts are One-penny, Two-penny, Three-penny ; *ditto*, large Four-penny ; *ditto*, large Five-penny, Six-penny.

For *Flooring*, plain or soft Wood Joists, the sorts are fourteen, fifteen, eighteen nineteen, twenty, twenty-one, twenty-two, twenty-three, twenty-eight, thirty-two, and thirty-six Pound per M.

Ditto strong, fit for hard Joists, the sorts are fifteen, eighteen, nineteen, twenty-four, and thirty-two Pound per M.

Quarter Head, for soft Wood, the sorts are ten, thirteen, fifteen, eighteen, nineteen, twenty, twenty-two, twenty-three, twenty-eight, and thirty-two Pound per M.

Ditto strong, for hard Wood Joists, the sorts are fourteen, twenty, thirty-four, forty-four, and fifty-four Pound per M.

N. B. All *Bill Brads*, alias *Quarter Heads*, are very fit for shallow Joints that are subject to warp ; or for Floors which are laid in haste, or by unskilful Persons, because the *Bill* with the Head will hinder the Boards from starting from the Joists ; but do not make so smooth Work as the plain *Brads*.

B R

As to the *Prices of Brads*, of which I shall set down a few, as follows : As *Joiners Brads*, the usual Price

d.

Of a M. of $\left\{ \begin{array}{l} 2 \\ 1\frac{1}{2} \\ 1 \end{array} \right\}$ Inch is $\left\{ \begin{array}{l} 20 \\ 15 \\ 11 \end{array} \right\}$

Quarter-Heads, or Bill-Brads, for soft Wood Floors, the usual Price

lb. s. d.

Of a M. of $\left\{ \begin{array}{l} 15 \\ 18 \end{array} \right\}$ is $\left\{ \begin{array}{l} 4 \\ 5 \end{array} \right\}$ 9 6

BRANCHES [in Architecture] are the Arches of *Gothic* Vaults. These Arches traversing from one Angle to another Diagonal-wise, form a Cross between the other Arches, which make the Sides of the Square of which the Arches are Diagonals.

BRAZING, the Soldering or Joining two Pieces of Iron, by Means of thin Plates of Brass melted between the two Pieces to be join'd.

If the Work be very fine, as when the two Leaves of broken Saws are to be join'd, it is cover'd with beaten Borax, moistened with Water, that it may be incorporated with the Brass Dust, which is here added ; and the Piece is exposed to the Fire without touching the Coals, 'till the Brass be observ'd to run.

Lastly, to braze with a still greater Degree of Delicacy, they use a Solder made of Brass, with a tenth Part of Tin ; or another, one Third Brass, and two Thirds Silver ; or Borax and Rosin ; observing, in all these Manners of

B R

Brazing, that the Pieces be join'd close throughout ; the Solder only holding in those Places that touch.

To **BREAK IN** [in Architecture] is a Term used by Carpenters, when they cut, or rather *break* a Hole in Brick-Walls, with a ripping Chissel.

BREST, a Term in Architecture, used, by some, to signify the same Member in a Column, that others call a *Thorus*.

BREST - SUMMERS, in Timber Buildings, are Pieces in the outward Parts of a Building, into which the Girders are framed in all the Floors but the Ground-Floor, then they call it a Cell ; and Garret-Floor, then it is call'd a Beam.

As to their Size and Square, it is the same according to the Act of Parliament, with that of Girders ; which see.

It is here to be observed, that it is not here meant, all the Pieces which have Girders in them, (and are not in the Garret, or Ground-Floor ;) but all such as are in the exterior Part of the Building ; whether in the Front, Flanks, or exterior Part of the Building ; for the Pieces in the Internal Part of the Building, into which the Girders are fram'd, are call'd *Summers*.

Mr. *Leybourn* says, that the *Brest-Summers*, in *London*, are measur'd by the Foot, running Measure ; but it is uncertain, whether he means only for the Work or Timber, or both.

Com. Comer says, that *Brest-Summers*, in *London*, are valued by the solid Foot ; if of Oak, 3 s. per Foot ; and if of Fir, 2 s.

BREW-

BREW-HOUSE. Sir *Henry Wotton*, in his *Elements of Architecture*, says, that all Offices which require *Heat*, as *Brew-Houses*, *Bake-Houses*, *Wash-Houses*, *Kitchens*, and the like, ought to be placed in the South Part of the Building, if the Position of the House, in respect to the High-Street, or the like, will admit of it; for it would be but an odd Contrivance, if a House stood on the North-Side of a High-Street, to place all the Offices in the Front of it; and it would be very ridiculous, to pass through a *Bake-House*, *Brew-House*, or *Wash-House*, into Rooms of Entertainment in a Nobleman's or Gentleman's House.

BRICKS, are a fat, reddish Earth, form'd into long Squares, four Inches broad, and eight or nine long, by Means of a Wooden Mould, and then bak'd or burnt in a Kiln, to serve for the Uses of Building.

Bricks are of a very ancient Standing, as appears from Sacred History, the Tower of *Babel* being built with them; and, as some say, the Remains thereof, are still in Being.

In the Times of the first Kings of *Rome*, they built with massive square Stones; which they learn'd from the *Tuscans*. Towards the latter End of the Republick, they began to use Brick, having borrow'd the Practice from the *Greeks*. And the greatest, as well as most durable Edifices, of the succeeding Emperors, as the *Pantheon*, &c. were built with *Brick*.

In the Time of *Gallienus*, the

Buildings were compos'd alternately, of an Order of *Brick*, and an Order of *Tofus*, a sort of soft gritty Stone.

After his Time, they laid aside the Use of *Bricks*, and resum'd *Flints*.

In the East, they bak'd their *Bricks* in the Sun. The *Romans* us'd them unburnt, only leaving them to dry for three, four, or five Years in the Air.

The *Greeks* principally used three Kinds of *Bricks*. The first were call'd *Didoron*, Διδωρον, i. e. of two Palms. The second, *Tetradoron*, Τετραδωρον, i. e. of four Palms. And the third, *Pentadoron*, Πενταδωρον, i. e. of five Palms. They had also other *Bricks* just half of these, to render their Works more solid, and also more agreeable to the Sight, by the Diversities of the Figures and Sizes of the *Bricks*.

Of the Matter whereof Bricks are made. *Pliny* says, if you would have good *Bricks*, they must not be made of any Earth that is full of Sand or Gravel, nor of such as is gritty or stony, but of a greyish Marl, or whitish Chalkey Clay, or at least, of a reddish Earth: But in case there is a Necessity to use that which is sandy, that is to be made choice of, which is tough and strong.

He also adds, that the best Season for making *Bricks*, is in the Spring; because they will be subject to crack and be full of Chinks, if made in the Summer. He directs, that the Loam of which the *Bricks* are made, be well steep'd or soak'd, and wrought with Water.

Mr.

Mr. *Inco* in *Mech. Exer.* says, that the Bricks made of the whitish Chalky Sort of Earth, and the reddish are the best.

At *Lunenburgh* in *Saxony*, their Bricks are made of a fat Earth, full of Allum.

At *Patana* in *Asia*, they make good Bricks of a Pumice Sort of Earth, which being dry'd will swim in Water, and not sink.

But here in *England*, they are for the most part made of a yellowish-colour'd fat Earth, somewhat reddish, vulgarly called Loam.

As for those Bricks made in *England*, they should not be of sandy Earth, which will make them both heavy and brittle; nor must the Loam be too fat, which will make them crack in drying; they should also be made either in the Spring or Autumn.

Mr. *Leyburn* says, that the Earth for Bricks ought to be digged before Winter; but not made into Bricks till the Spring-Season.

When Bricks have been made, they should be sheltered from the Sun, if it be too hot, but yet must be expos'd to the Air to dry. If they be made in frosty Weather, they must be covered with Sand, and in hot Weather, with wet Straw.

Of their Kinds and Appellations. Bricks, among us, are various, acquiring various Forms, Dimensions, Uses, Method of making, Place where, &c. Those from their Form, are *Compass-Bricks*, of a circular Form, used in steyning of Walls. 2. *Concave*, or *Hollow Bricks*, on one Side flat, like a common Brick, on the other hollow'd. They are

used for the Conveyance of Water. 3. *Feather-Edg'd Bricks*, which are like the common *Statute-Bricks*, only thinner on one Edge than the other, and are used for penning up the Brick-Pannels in Timber-Buildings. 4. *Triangular Bricks*.

1. Those, from their Dimensions, are the Great and Small, or Statute, and Didoron, Tetradoron, and Pentadoron.

2. Great Bricks are twelve Inches long, six broad, and three thick; the Weight of one is about fifteen Pounds, so that a hundred will weigh fifteen hundred Pound, and a thousand of them fifteen thousand Pounds.

3. Those from Custom, are, *Statute* and *Cogging-Bricks*.

Cogging-Bricks are used for making the indented Work under the Coping of Walls built with great Bricks.

4. Those from the Method of making, are *Place* and *Stock-Bricks*. *Place-Bricks* are such as are made in a Place prepared on purpose for them, near the Building they are to be used in. *Statute-Bricks*, or small common Bricks, ought to be nine Inches long, four and a half broad, and two and a half thick.

5. Those from the Place, where, or by whom, are *Dutch*, or *Flemish*: These are used in paving Yards, or Stables, and for Soap-Boilers Fats and Cisterns.

6. Those from their Use, are *Buttress*, or *Pilaster*, *Coping* and *Paving-Bricks*. *Buttress* or *Pilaster-Bricks*, which are of the same Dimensions with the *Great Bricks*, only they have a Notch at one End of half the Breadth of the Brick. Their Use is to bind the

the Work at the Pilasters of Fence-Walls which are built of *Great Bricks*. *Coping-Bricks* are form'd on Purpose for Coping-Walls; *Paving-Bricks*, or Tiles, are of several Sizes in several Counties and Places.

7. Those from Accident, are *Clinkers*, *Samel* or *Sandal*. *Clinkers* are such *Bricks*, as are glazed by the Heat of the Fire, in making. *Samel* or *Sandal-Bricks*, are such as lie outmost in a Kiln or Clamp, and consequently are soft and useless, as not being thoroughly burnt.

Of all which, I shall treat in their Order.

1. *Compass-Bricks*, are, as has been said, of a circular Form; and their Use is for stayning of Walls; which is perform'd in the Manner following:

A good Bed of Clay is first laid for the Bottom, and then it is pav'd with *common* or *Statute-Bricks*, only laid down, and well settled on it; which being done, the *Compass-Work* is begun with *Compass-Bricks*, and as the Courses are carried up, they ram Clay in behind them, (Room being left behind for that Purpose,) which causes all the *Bricks* to pen tight and close together.

An experienced Workman says, he has done this Sort of Work, where the Walls have gone but a little Depth in the Ground, and in a loose and open Mould, where the Water has been brought in by *Concave-Bricks*; which held very well for thirty Years.

As to the Price of these *Bricks*, it is not certain; but they are not much dearer than *common* or *Sta-*

tute Bricks; but the Person who has them made for his Use, is usually at the Charge of a Mould, made according to the Circumference of his Wall.

2. *Concave* or *Hollow-Bricks*. These are like *common* or *Statute-Bricks* on one Side, but have a Concavity or Hollowness on the other, which is semicircular.

This Hollowness is about three Quarters of an Inch deep, and an Inch and half broad, so that two of these *Bricks* being placed with their Hollows together, they are like a Pipe of an Inch and half Bore. These *Bricks* are usually about twelve Inches in Length, four and a half in Breadth, and two and a half in Thickness.

As to the Manner of laying them in the Ground, it is usually done in Clay: But it should be carefully minded, that no Trees, Bushes, or Brambles, be suffer'd to grow over where these *Bricks* are laid for the Conveyance of Water, nor yet very near them; because their Roots are apt to get in betwixt the Joints of the *Bricks*, and there to spread themselves with Fibrous Roots, which meeting together like a Ball of Hair in the Concavity, will in Time stop up the Passage, and hinder the Currency of the Water. Which Inconvenience could it infallibly be prevented, it would be the cheapest Way of conveying Water to a House; for *Bricks* to the Value of seven or eight Shillings, will do about six Rods; and supposing the Workmanship in digging the Trench, laying the *Bricks*, Charge of the Clay, and ramming up again, to be as much

much more, one Rod would cost but two Shillings and two Pence, or two Shillings and eight Pence; and would not be one sixth Part of the Charge of Leaden Pipes, and altogether as serviceable, if not more; because they would last (as may be said) for ever: And preferable to Lead, if (as we may suppose) the Frost would not hurt these; whereas it frequently bursts Leaden Pipes. For though the Water should be frozen up in them, and we may reasonably suppose that the Ice would then, by expanding itself, open the Joints of the *Bricks*; yet it is reasonable to suppose, that after the Frost is gone, they will come together in their due Places, by the natural Gravity of the Earth; for then there will be no solid Body betwixt the Joints to hinder the *Bricks* from closing again.

And as to *Alder Pipes*, altho' they be much cheaper than Lead, these of *Bricks* will not come to much above (if any Thing at all) half the Price of *Alder Pipes*.

As to the Price of these Concave Bricks: They have been sold in *Kent* for four Shillings per Hundred, and in *Sussex* for three Shillings; two hundred of these *Bricks*, being a Foot in Length, will lay six Rods.

3. *Cogging Bricks* are a Sort of *Bricks* in Use in some Parts of *Sussex*, for making their Tooothing or indented Work under the Coping of Walls, which are built of great *Bricks*.

They are in Length about ten Inches, in Breadth four, and in Thickness two and a half, and are usually sold at the Price of common *Bricks*.

The Use of these are to lay on the Tops of Walls, just under the *Coping Bricks*, in an oblique Position; so that one Corner or Angle projects over about two Inches and a half on the Side, and the opposite diagonal Angle at the other, and projects as much over the other Side.

4. *Coping Bricks* are to be used with great *Bricks* in building Fence-Walls; and are much used in some Parts of *Sussex*.

As to the Size and Form of these *Coping Bricks*, they are as follow: *viz.* They are about twelve Inches square, and four Inches and a half thick, having one Side flat, or plain, and two flat Ends; and the two Edges and upper Side are comprehended under one curvilinear Surface; the two Edges consisting of two Boultings, joined by two Casements, or Hollows to an Astragal, which is the Top of the *Brick*, in this Form . Their usual Price is from twelve to sixteen Shillings per Hundred.

5. *Dutch or Flemish Bricks* are in Length about six Inches and a quarter, in Breadth two and a half, and in Thickness one and a quarter; or, as some, who have measured them, say, six Inches long, three broad, and one thick. They are of a pale Colour, inclining to Yellow.

They are commonly used here in *England* for paving Yards and Stables, for which they make good Pavements, and are very lasting; and being laid edge-ways, are neater and stronger than common *Bricks*, and look very handsomely, especially if laid Her-ring-bone Fashion.

They

They must be laid in Sand.

They are also used in making Fats and Cisterns for Soap-Boilers.

Of these *Bricks*, which are six Inches and a quarter long, and two and a half broad, allowing a Quarter of an Inch for the Joints, 72 will pave a Yard square; but if they be set on Edge, it will take up about 113 to pave a Yard square.

But of the other Size, of six Inches in Length, three in Breadth, and one in Thickness, sixty-three being laid flat, will pave a Yard square; but being set edge-ways, it will require one Hundred and sixty-five to do the same.

These *Bricks* are commonly sold at London at two Shillings per Hundred.

6. *Clinkers*, are such *Bricks* as have much Nitre or Salt-Petre in them; which, by reason of the Violence of the Fire, runs and glazes them.

7. *Didoron*, a sort of *Bricks* used by the Ancients; in Length two Spans, or a Foot and half, [the Word *δωρον*, *Doron*, being Greek for a Span, or the Space between the Top of the Thumb and little Finger extended,] and a Foot in Breadth.

These were the smallest Sort of *Bricks* used by the Greeks in their private Buildings; but for their public Buildings, they had two larger Sizes, as you will find hereafter, called *Tetradoron*, and *Pentadoron*.

8. *Feather-edg'd Bricks*, are a sort of *Bricks* formerly used in Kent and Suffex; they are of the same Size as common *Bricks*, but are made thinner at one Edge

than they are at the other, on purpose to pen up their Brick Pannels (as they call them) in Timber Buildings, and were commonly sold among the Statute *Bricks* for that Purpose.

9. *Great Bricks*, are a sort of *Bricks* that are twelve Inches long, six Inches broad, and three Inches thick.

The Weight of one of these *Bricks* has been found to be sixteen Pound; so that one Hundred will weigh one thousand five hundred Pounds, and one Thousand 15000 Pounds; which amounts to six Tons, thirteen Hundred, three Quarters, and twenty Pounds; and so one Hundred and fifty will be a Ton Weight.

These *Bricks* are used in building Fence-Walls, together with *Pilaster* or *Buttress Bricks*, and *Coping Bricks*. These Walls are no more than six Inches thick, except at the *Pilasters*, where they are twelve; and it is usual to set a *Pilaster* at every ten Feet.

There is a Wall, about nine Feet high, built with these sort of *Bricks*, that stands very well, that has been built near thirty Years.

These Walls are reckon'd by some to be much cheaper than those of a *Brick* and half, or fourteen Inches of *Statute Bricks*. See *Walls*.

These *Bricks* are sold by the Thousand at forty Shillings the Thousand, or four Shillings the Hundred.

10. *Paving Bricks*: Of these there are various Sizes, according to the Fancy of the Workman, and the Custom of the Places.

Places. Mr. *Leybourn* says, they are six, eight, ten, and twelve Inches square, and are sold from six to twenty Shillings *per Hundred*. Some call them *Tiling-Bricks*.

Note, That $\left\{ \begin{array}{l} 9 \\ 13 \\ 21 \\ 36 \end{array} \right\}$ Bricks of $\left\{ \begin{array}{l} 12 \\ 10 \\ 8 \\ 6 \end{array} \right\}$ Inches square, will pave a Yard square.

Paving-Bricks are made in *Surrey*, and several Counties in *England*, of three several Largenesses, *viz.* twelve Inches square, and an Inch and half thick ; ten Inches square, and an Inch and quarter thick ; and eight Inches square, and one Inch thick : Either of which Sorts being polished or rubbed with sharp Sand on the Surface, and well-joined, and the Sides rendred equal, by hacking them with a Brick-Ax, and rubbing them with a Rubbing-Stone with sharp Sand, makes an excellent Pavement, very handsome to the Sight, especially when laid Arras-ways.

There have been made in *Sussex Paving-Bricks* six Inches and a half square, and an Inch and seven Eighths thick ; two of which have weighed 11 lb. so that a hundred of them would weigh 550 lb. and a thousand, 5500 lb. and consequently, four hundred and seven of them would weigh a Ton.

Some have been made in *Sussex* nine Inches square, which were usually sold for 8s. *per Hundred*.

An experienced Brick-Maker says, that he had made *Paving Bricks* of Clay, fifteen Inches square, but found much Trouble to prevent their warping.

These *Bricks*, when burnt, were of a pale red Colour ; as were also some which he made six Inches square of another sort of Clay, some Miles distant from the former.

He likewise says, that *Paving-Bricks* made of Loam, are reddest in Colour when burnt ; but ought to be made of better Earth than common *Bricks*, though they seldom are by those who make them for Sale.

He adds, that beside the Goodness of the Earth, in *Paving-Bricks*, there ought to be a great deal of Care taken in the drying them, to hinder them from warping ; and that when they have been dry'd, in dressing them smooth and straight, especially on the uppermost Surface, and also in paring the Edges straight, and a little under, making an acute Angle with the upper Side, and in seeing that they be exactly square before they are put into the Kiln to be burnt.

The common Price of nine or ten Inch *Paving-Bricks* is from 8s. to 12s. a Hundred in the Country.

Those of ten Inches have been brought by Water from *Surrey*, to Seaport Towns in *Kent* and *Sussex*, and sold for 10s. a Hundred.

11. *Pentadoron-Bricks*, are a kind of *Bricks* anciently in Use among the *Greeks*, being three Foot nine Inches long, and one Foot broad, with which they built their publick Edifices.

12. *Place-Bricks*, are all Sorts of *Bricks*, made after the following Method, from whence they derive their Name :

Workmen, say they, are forced to use more than one Method of making *Bricks*; not purely for the sake of Fancy, but out of pure Necessity : The Reason of which proceeds from certain different Qualities inherent in different *Earths*.

Place-Bricks and *Stock-Bricks*, are the two Kinds that take their Names from the Method of their making.

Place-Bricks are generally made in the Eastern Part of *Sussex*, so called, because there is a Place hard by, where they strike (or mold) their *Bricks*, which is a level smooth Piece of Ground, prepar'd for the Bearer-off, (i. e. him who carries the *Bricks* from the Striker,) to lay them down singly in Rows (which are by them called Ricks,) as soon as they are molded ; where they are let lie 'till they are a little dry'd, viz. 'till they are stiff enough to be turn'd on their Edges, and dress'd, (i. e. 'till their Inequalities are cut off,) and when they are dry'd, they carry them to the Hacks, (or Places where they are row'd up like a Wall of two *Bricks* thick, with some small Intervals betwixt them, to let in the Wind and Air to dry them.) When the Hack is filled, they cover them with Straw on the Top,

till they are dry enough to be carried to the Kiln, to be burnt.

13. *Pilaster*, or *Buttress-Bricks*, are made of the same Length, Breadth, and Thickness, with the *Great Bricks*, six and nine. The only Thing they differ from them, is this ; They leave a Notch at one End, which is half the Breadth of the *Brick*, and made of the same Mold with the *Great Bricks* ; only in making *Pilaster-Bricks*, they put a Cube of Wood of three Inches square into one Corner of the Mold, which Piece makes the Notch in the *Bricks* in the Molding. These *Bricks* are used to bond the Work at the *Pilaster* of *Fence-Walls*, built of *Great Bricks*.

These *Pilasters* are made of a Foot square, viz. a *Brick* in Length, or two *Bricks* in Breadth alternately, throughout the whole Height of the *Pilaster* : So that the *Pilaster* stands out three Inches beyond the Surface of the Wall, on each Side.

14. *Samel*, or *Sandal-Bricks*, are such as lie outmost in a Kiln or Clamp, where the Salt-Petre not being digested for Want of Heat, they are very soft, and will soon moulder to Dust.

15. *Stock-Bricks*, differ not from *Place-Bricks* in Form ; but their Difference lies in the Quality of the Earth. They are made upon a Stock, viz. the Mold is put on a Stock, after the same Manner of molding or striking of Tiles ; and when they have molded one *Brick*, they lay it upon a little Piece of Board, somewhat longer than the *Brick*, laying another Piece of Board on that *Brick*, like the first, and ano-

ther *Brick* on that; after this Manner, laying three *Bricks* one upon another, continuing so to strike, and lay them on the Stage, as they do Tiles, till the Stage is full; and then they are carried away by Three and Three successively, to the Hacks, and there turn'd down on their Edges; so that there will be the Thickness of a thin Piece of Board, between every *Brick*.

When the Hack has been filled with one Height of *Bricks* from End to End, then they begin to set them upon those which were first laid on the Hack, by which Time, they will be a little dry'd, and will bear the others, being molded of very stiff Earth. By that Time they come to set a Second, or Third, &c. At which Time, they cater them a little, (as they call it,) to prevent their reeling: And when the Hack is of a proper Height, they cover them with Straw, after the same Manner as they do *Place-Bricks*, till they are dry enough for Burning.

This, they say, being more Trouble than the other Way, viz. of making *Place-Bricks*, for making and burning (besides the digging of the Earth,) they have 6s. a Thousand, which is 1s. more than they usually have for making *Place-Bricks*; but they are under a Necessity to make them after this Manner; or else if they were laid abroad in a Place to dry, as the *Place-Bricks* are, the Quality of the Earth is such, that they would burst to Pieces.

There is an Instance of this, which is related by an experien-

ced Brick and Tile-Maker, (who was used to work in *Kent* and *Sussex*,) who being sent for to *Rumford* in *Essex*, to make a hundred thousand of *Bricks*, he unadvisedly, not knowing the Quality of the Earth, having struck about a thousand, they being set down to dry, after the Method of *Place-Bricks*, and lain till about Ten a-Clock, the Sun beginning to shine very hot, the whole Thousand of *Bricks* burst to Pieces, so that he was forced to throw them away, and go to work afresh; and thatching them (i. e. covering them) with Straw till the next Morning, and then raking it off, the *Bricks* did very well, when they came to be set on the Hack; and after they had been burnt, were curious red *Bricks*, which would ring, being struck with any hard Thing.

At this Place, they made none but *Stock-Bricks* before he found out the Way of making *Place-Bricks* of this Earth.

16. *Statute, Small, or Common Bricks*. Their Dimensions, viz. of the Mold, according to the Statute, ought to be as follows, viz. nine Inches in Length, four and a half in Breadth, and two and a quarter in Thickness within.

Bricks made in a Mold of these Dimensions (the Earth being first well-temper'd) being dry'd and burnt, will be lesser and lighter; yet they shrink but little in Thickness, less in Breadth, and scarce any Thing discernible in Length. As to the Weight of *Bricks*, that is uncertain, there being a great Difference in the Gravities of Earths; yet in common, a single

gle *Brick* will weigh about five Pounds, and contain ninety Cubick Inches; and from some Molds a hundred.

Four *Bricks* being measured, and weighed, each being nine Inches long, four and a quarter broad, and two and one Third thick, weigh'd twenty-two Pounds; so that a single *Brick* weigh'd five Pounds and a half, a hundred of which, at that Rate, would weigh five hundred and fifty Pounds; and a thousand, five thousand five hundred Pounds; and about four hundred and seven would be a Ton Weight.

These were *Suffex Bricks*, of which they usually reckon five hundred to the Load; which Number of *Bricks*, according to this Proportion, will weigh about twenty-four hundred and a half.

These *Bricks* are often used in paving Cellars, Wash-Houses, Sinks, and Fire-Hearts, and the like; thirty of which made, according to the Statute, will pave a Yard square, and three hundred and thirty of them, a Square of an hundred Foot, being laid the flat Way, and not set edgeways; for then it will require near as many more.

It has been found by Observation, that thirty-two *Bricks* laid flat, will pave a Yard square; and sixty-four set on edge will do the same.

It is also found by Experience, that four thousand six hundred *Statute-Bricks* will be required to make a superficial Statute-Rod of Brick-Work of a *Brick* and half thick, and consequently seventeen hundred to the Square,

and an hundred and fifty-five to the superficial Yard, on a Wall of a *Brick* and half thick.

As to the Price of these *Statute or Common Bricks*, it is various, according to the different Places; for they have different Prices in different Parts of the Kingdom; which is not all neither; for *Bricks* in the same Kiln shall have a different Price, according to the Distance the Master of the Brick-Work is to send them; and also some Consideration is to be had of the Price of Fuel, and Workmens Wages.

Mr. *Leyburn* says, he never knew them cheaper than 9s. nor dearer than 18s. delivered in any Part of London.

Statute or Common Bricks have been sold in some Parts of *Suffex* and *Kent* for 16s. a Thousand, laid down within two Miles distant from the Kiln; and at other Times, they have been sold at 20s. a Thousand.

At another Place in *Suffex*, they are sold at 25s. a Thousand, if laid down within two or three Miles distant from the Kiln: Whereas within twelve or fifteen Years they have been sold for 20s. a Thousand. But since the Beginning of the late Wars, the Iron-Works in that Part have consum'd so great a Quantity of their Wood, that Fuel, of late Years, is grown to a fourth Part, or more, dearer than it used to be; for which Reason, they have since raised their *Bricks* to 25s. a Thousand.

Mr. *Wing* says, that in *Rutland*, *Bricks* are but 12s. a Thousand at the Kiln.

As to the Price of making *Statute-Bricks*, the common Price

in the Country, is 6*d.* a Thousand for the Molder, 4*d.* for the Bearer-off, and 4*d.* for the Digger and Temperer of the Earth fit for Use; and the Digger of the Earth for making it ready after it is digged, the Digging not being reckon'd into the Making, Molding, Bearing off, &c. and Burning, the usual Price is 5*s.* a Thousand.

Mr. *Leyburn* informs us, that about *London*, they allow the Molder 4*d.* 5*d.* or 6*d.* a Thousand; and that *Bricks* made at Home, will stand the Maker of them in (besides the Value of the Earth) betwixt 5 and 6*s.* per Thousand.

But it will be more in some Parts of *Kent* and *Suffex*.

17. *Tetradoron*, a Sort of ancient *Grecian Bricks*, which were three Feet or four Spans in Length, and one Foot in Breadth, being one of their larger Size, with which they built their publick Buildings.

Triangular Bricks. *Daniel Barbaro*, Patriarch of *Aquila*, in his Comment on *Vitruvius*, recommends another Form of *Bricks*, viz. Triangular ones, every Side a Foot long, and some an Inch and half thick: These, he observes, would have many Conveniencies above the rest As, First, being more commodious in the Management. Secondly, of less Expence. And, Thirdly, of fairer Shew; adding much Beauty and Strength to the Mural Angles, when they fall gracefully into an indented Work.

Sir *Henry Wotton* wonders they have never been brought into Use, being recommended by so great an Authority.

[The Method of burning *Bricks*.] The *Bricks* or Kiln being set, and covered with Pieces of *Bricks*, they first put in some Cord or great Wood to dry them with a gentle Heat or Fire; and this they continue till the *Bricks* are pretty dry; which is known by the Smoke's turning from a whitish darkish Colour, to a black transparent Smoke. They then leave off putting in Wood, but proceed to make ready for burning; which is perform'd by putting in Bush, Furze, Spray, Heath, Brake, or Fern Faggots; but before they put in any Faggots, they dam up the Mouth or Mouths of the Kiln with Pieces of *Bricks*, (which they call *Shinlog*,) piled up one upon another, and close it up with wet Brick-Earth instead of Mortar.

This *Shinlog* they make so high, that there is but just Room above it, to thrust in a Faggot betwixt one Foot and a half and two Foot; for the whole Height of the Mouth is but three Foot.

The Mouth being thus *shinlog'd*, they then proceed to put in more Faggots, till the Kiln and its Arches look white, and the Fire appear on the Top of the Kiln, and the Kiln and Ashes below begin to change from a white to a greyish Colour. Then they slacken the Fire for some Time, viz. for half an Hour or an Hour, that the Fire or Heat may ascend to the Top of the Kiln, by the Motion of the Air in at the Mouth; and also that the lower Ware may settle and cool, and not be burnt more than that above it.

Thus

Thus they continue to do, heating and slackening alternately, till all the Ware is thoroughly burnt; which will be commonly in about forty-eight Hours.

As to the cooling of Kilns of Ware, some unskilful Burners do, as soon as the Ware is burnt, immediately stop up the rest of the Mouth of the Kiln, which was left open above the Mouth of the Shinlog, which causes it to be long a cooling; by which Means a Kiln will be ordinarily a Fortnight or three Weeks in setting, burning, cooling, and drawing: Whereas an experienced Burner has affirmed, he has set, burnt, cool'd, and drawn a Kiln a Week, for several Weeks successively, one after another; but then he never stopped up the rest of the Kiln's Mouths above the Shinlog, but left it open for the Air to go in, and cool the Kiln of *Bricks*.

He adds also, that six hundred of Faggots, will burn a Kiln of ten or eleven thousand *Statute Bricks*. And Mr. *Wing* says, that a Chaldron of Coals will burn four thousand two hundred *Bricks*.

By the foregoing Method, a Kiln of *Bricks* may be burnt so equally, that those on the Top shall be burnt as hard as those at the Bottom: So that an expert Burner affirms, he has burnt several Kilns of Tiles and *Bricks* together, about three thousand *Bricks*, and ten or eleven thousand of Tiles, and has not had above fifty waste, broken and sandal, Tiles in all: Whereas such Brick-Burners as continue their Fire without any Inter-

mission, render their lower *Bricks* extremely hard, and those on the Top *Samel Bricks* or Tiles: Nay, what is worse, they cause the lower ones to run so, by excessive Heat, that they are almost united in one entire Body; so that they are forced to get them out with Wringers, (or Iron Bars,) and each Bolt of Tiles shall be one entire Mass.

About *London*, they burn their *Bricks* in Clamps built of the *Bricks* themselves, after the Manner of Arches in Kilns, with a Vacancy between each *Brick's* Breadth, for the Fire to play through; but with this Difference, that instead of arching, they span it over, by making the *Bricks* project one over another on both Sides the Place for the Wood and Coals to lie in, till they meet, and are bonnded by the *Bricks* at the Top; which close all up, projecting over inwards, till they meet in the Middle; which they will do in about three or four Courses of *Bricks* in Height.

The Place for the Fuel is carried up straight on both Sides, or, which is the same Thing, upright on both Sides, till it is about three Foot high; then they fill it almost with Wood, and lay a Covering of Sea-Coal over that; and when that is done, they over-span the Arch: But they strew Sea-Coal also over the Clamp, betwixt all the Rows of *Bricks*; for they are not laid contingent in their vertical Rows; and one Course of *Bricks* is laid one one Way, and another another; so that there are small Interstices through all

the *Bricks*, for the Coals to be strewed into. When this is done, they fire the Wood, and that fires the Coals; and when all is burnt, they conclude the *Bricks* are burnt enough.

Mr. *Goldman* observes, that *Bricks* will have double the Strength, if after one Burning they be steeped in Water, and burnt afresh.

If the Earth be too fat, it must be temper'd with Sand, and that trod out again, first by Cattle, afterwards by Men.

Bricks made of common Earth melt, nay, often vitrify, by too much Heat: For which Reason, the Kilns are made of Stones, which will themselves calcine, that the Vehemence of the Fire may be broken: Besides which, they usually place other *Bricks* made of an Argillous Earth, which would melt next the Fire.

What Quantity of Earth will make a thousand *Bricks*?

Some say, that a Load of Loam (a Load being twelve Bushels) will make about two hundred *Statute-Bricks*; and if so, consequently five Loads will make a thousand: Also that nineteen Load will make sixteen hundred of *Great Bricks*; and twelve will be sufficient for a thousand of the same.

Of the Choice of Bricks: Pliny advises, in chusing of *Bricks* for building, to procure (if it can be) such *Bricks* as are two Years old at least.

There are generally in all Kilns, or Clamps, *Bricks* of three Degrees in Goodness.

The first and best Sort are such as lie next the Fire, (*viz.*

those are best for lasting, which have, as it were, a Gloss on them, which proceeds from the Saltpetre which is inherent in them, and which runs, and glazes them, by Means of the Violence of the Fire. These are called *Clinkers*.

The second, and most general Sort for building, are those which lie next in the Kiln, or Clamp, to those *Clinkers* before mention'd.

The third and worst Sort, are those which lie on the Outfides of the Kilns and Clamps, where the Saltpetre in them is not digested for want of due Heat. And these, when they come to be exposed to the Weather for some Time, will moulder away into Dust. These are called by Bricklayers, *Samel* or *Sandal-Bricks*.

It is an Observation, that whilst *Bricks* are burning, those on the Inside of a Clamp are the worst of all.

Mr. *Worlidge*, in his *Systema Agriculture*, is for exciting the Brick-Makers to try their Skill in making a Composition of Clay and Sand, to form in Molds, Window-Frames for Houses of different Forms and Sizes; and also Chimney-Pieces, and Frames for Doors, &c. in several Pieces made in Molds, that when they have been burnt, they may be set together with a fine Cement, and seem to be but one entire Piece, by which Means all manner of Stone-Work now used in Building, may be imitated: Which would very well supply the Deficiency of Stones, where they are either wanting, or scarce and dear; and at the same Time, save

save a great Deal of Timber now used in Brick-Building, and appear much more compleat and beautiful, and be of greater Strength, and more durable for lasting, than Timber or ordinary Brick.

And one would imagine it very practicable, as may be perceiv'd by the Earthen Pipes made fine, thin, and durable, for the Conveyance of Water under Ground at *Portsmouth* in *Hampshire*, and by the Earthen Backs for Grates and Chimneys, formerly made by Sir *John Winter*, at *Charing-Cross*. Which are evident and sufficient Demonstrations of the Possibility of making Work fine, thin, and light, for Tiles of a large Size and Thickness, either plain, or curved, and of making larger Work in Molds, and by burning them for Doors, Windows, and Chimney-Frames.

This, says he, is one of the most feasible and beneficial Operations that I know to be neglected in *England*.

Another Author says, he really thinks much might be done as to making of Chimney-Pieces, Stone-Moldings, and Architrave-Doors and Windows, and Architraves, or Fascia's for Fronts of Buildings. If Men of this Profession would but apply their Minds to find out some good Composition of Earth, and a Method of managing it well in molding, burning, &c.

It may be questionable, whether a Composition of Earth, something like to common Crockers Earth, would not in some Measure answer the Purpose, since it appears plainly, that

what Form soever they put their Earth into, the same it retains after drying and burning, although Crocks, and such like Things, are form'd very thin.

Now suppose that Chimney-Pieces, or the like, were made in Molds, and afterwards dry'd and burnt, if they were not thought smooth enough when they were set up, they might be polish'd with sharp Sand and Water, or a Piece of sharp Stone and Water.

Or if Care were taken of such Things as these (which are for Ornament, as well as Use,) when they were half dry, or more, in the Air, they might be polish'd over with an Instrument for the Purpose of either Copper, Iron, or some hard Body, and then left to dry till they were dry enough for burning. If so, 'tis probable, they would not need much Polishing afterwards.

It is likewise as probable, that ingenious Workmen might make very handsome and beautiful Chimney-Pieces, Stone-Moldings for Doors, &c. fit for Noblemens Houses, and all others who would be at the Charge.

These might be glazed, as Potters do their fine Earthen Ware, or else vein'd, in Imitation of Marble, or be painted and anneal'd with Figures of various Colours, either History, Perspective, or the like; which would be much cheaper, if not also as durable as Marble itself.

It is not, says a certain Author, the Want of Materials, but Want of Skill and Diligence in managing them, that makes our *English* Buildings in the least Mea-

sure inferior to any of those in foreign Countries.

A certain *English* Ambassador made this Observation, That we ought not to be discouraged with our ignoble Materials for Building, which we use in *England*, in Comparison with the Marbles of *Asia* and *Numidia*: For, says he, I have often viewed, with much Pleasure, at *Venice*, an Antiporch after the *Greek* Manner, erected by *Andreas Palladio*, upon eight Columns of the *Roman* Order, the Backs of Stone without Pedestals, the Shafts or Bodies of mere *Brick* three Foot and a half in Diameter below, and of Consequence thirty-five Foot high, than which, he saith, his Eyes never beheld any Columns more stately of Stone, or Marble. The *Bricks* being first form'd in a circular Mold, were cut before they were burnt, into four quarters, or more Parts, and afterwards, jointed so closely and nicely in laying, and the Points so exactly concentered, that the Pillars appeared to be of one entire Piece.

[Things worthy to be observed in buying and laying of *Bricks*.]

I. As to buying: The seventh Number will be a sufficient Direction to any Workman, (who does not understand it,) to chuse good *Bricks*. And in the 16th Section of *Bricks*, viz. under the Head of *Statute Bricks*, there are Directions as to the Number of *Bricks* that will make a Square or Rod of Work; though 'tis impossible to be exactly certain to a very few; because, First, the Workman's

Hand may vary in laying the Mortar. Secondly, many *Bricks* may warp in burning; and the Seller will bring you some such. Thirdly, some will be broken and spoiled in the Carriage. Fourthly, you will often find the Tale deficient, if you be not extraordinary careful.

And besides this, when *Bricks* are dear, and Lime cheap, and you put your Work out by the Great, or by Measure, and the Workman to find Materials, he, except he be well look'd after, will use the more Mortar, and the fewer *Bricks*, making large Joints, which is a Defect in any Building.

II. As to laying *Bricks*, which is a Thing of no small Consequence in any Building, in order to the Well-working and Bonding of Brick-Work, (or as it is called by some Workmen, Breaking of Joint,) conduces very much to its Strength. It will not therefore be improper to add some particular Directions concerning it, which have been recommended by experienced Workmen.

1. Take Care to procure good strong Mortar. See MORTAR.

2. If your *Bricks* are laid in Winter, let them be kept and laid as dry as possible. If they are laid in Summer-Time, it will quit Cost to employ Boys to wet them; because being wetted, they will unite much better with the Mortar, than if they were laid dry, and will render the Work much stronger.

But

But if it shall be objected, that if the Building be large, it will be a great deal of Trouble to wet all the *Bricks*, by dipping them in Water; and also that it will make the Workmens Fingers sore in laying them.

To prevent these Inconveniencies, Water may be thrown on each Course of *Bricks* after they have been laid; as is said to have been done by the Order of the ingenious Mr. *Robert Hook*, the Surveyor at the Building of the *Physicians College* in *Warwick-Lane*.

3. If *Bricks* are laid in the Summer Time, don't fail to cover them, to prevent their drying too fast; for if the Mortar dry too hastily, it doth not cement so firmly to the *Bricks*, as when it dries leisurely.

4. If the *Bricks* are laid in the Winter Time, take care to cover them well, to defend them from Rain, Snow, and Frost; the last of which is a mortal Enemy to all Mortar, especially to all such as have taken Wet just before the Frost seizes it.

5. Take care that *Bricks* be not laid Joint on Joint on the Middle of Walls, but as seldom as may be; but let there be good Bond made there, as well as on the Outides: For some Workmen, working a Brick and half Wall, lay the Header on one Side of the Wall, perpendicular on the other Side of the Wall; and so all along through; which, indeed, necessarily follows, from the unadvised Setting up of the Quoin at a Toothing; for it is common to tooth in the Stretching-Course two Inches with the Stretcher only; and the Header

on the other Side to be perpendicular over the Header on this Side; which causes the Headers to lie Joint in Joint in the Middle of the Work.

Whereas if the Header on one Side of the Wall, were tooth'd as much as the Stretchers on the other Side, it would be a stronger Toothing, and the Joints of the Headers on one Side would be in the Middle of the Headers of the Course they lie upon on the other Side.

All that can be pretended in Excuse of this ill Practice in working thus, is this: That the Header will not hang two Inches over the *Bricks* underneath it.

This, indeed, is an Objection: But yet the Inconveniency may be avoided without much Difficulty, viz. as follows: By having a Piece of Wood of the Thickness of a Course of *Bricks*, and two Inches broad, and laying it on the last Toothing-Course, to bear it, or a Brick-Bat put upon the last Toothing, will bear it till the next Quoin is set upon it, and then the Bat may be taken away.

6. The same Inconvenience, at an upright Quoin in a Brick and half Wall; where it is usual to lay a Closer next the Header, on both Sides of the Walls; and in so doing, 'tis Joint in Joint all the Length of the Wall, except by Chance, a Three-Quarter Bat happen to be laid.

In order to avoid this Inconveniency, and by that Means to make the Wall much firmer, lay a Closer on one Side; but lay a Three-quarter Bat on the Stretching-Course, and join a Header

next to the Header, at the Quoin in the Heading Course.

7. Also in two Brick-Walls, it will be the best Way in Stretching-Courses, in which Stretching is laid on both Sides the Walls next the Line, to lay also Stretching in the Middle of the Wall, and Closes next to each Stretching-Course which lies next the Line.

[What Number of *Bricks* may be laid in a Day.] A Bricklayer and his Labourer (all their Materials being ready) will lay in a Day about a thousand *Bricks*, in whole Work, on a solid Plain; and some dexterous Bricklayers will lay twelve, and some fifteen hundred.

[Of Facing Timber-Buildings with *Bricks*.] This may be more properly called Casing; it being covered all over on the Outside with *Bricks*, so that no Timber is to be seen. The Manner of performing it, is as follows; *viz.* All betwixt the Timber and the Wall is a *Brick's* Length thick, (or Nine-Inch Brick-Wall,) but against the Timber, the Wall is but four Inches and a half, or

a half *Brick* thick, beside the Timber.

But experienced Workmen do not approve of this Method; because the Mortar does so much corrode and decay the Timber.

An experienced Bricklayer says, that in pulling down Work at *Eridge-Place*, (which is one of the Lord *Abergavenny's* Country Seats,) the Timber was extremely corroded and eaten by the Mortar.

BRICKLAYERS WORK, what.] In the City of *London*, &c. it consists of several Kinds, *viz.* Walling, Tiling, Chimney-Work, and Paving with Bricks and Tiles.

But in the Country it is common for the *Bricklayers* Trade to comprehend those of the Mason and Plasterer also: But I shall here consider it only as to the particular Branches of Walling, Tiling, Chimney-Work, Paving, &c.

[As to writing a *Bricklayer's* Bill.] A *Bricklayer's* Bill may be made after the Method following:

Mr.

Mr. WILLIAM BLAKEWEY's Bill of Materials had of, and Work done, by Thomas Halling, Bricklayer; June 5. 1732.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
For eight thousand of Bricks, at 12 <i>s.</i> per M.	4	16	0
For four thousand of Tiles, at 20 <i>s.</i> per M.	4	0	0
For fifteen Hundred of Lime, at 12 <i>s.</i> per C.	9	0	0
For fourteen Load of Sand, at 2 <i>s.</i> 6 <i>d.</i> per L.	1	15	0
For five Hundred Nine-Inch Paving-Tiles, at 11 <i>s.</i> per Hundred	2	15	0
For thirty Ridge-Tiles, at 1 <i>d.</i> $\frac{3}{4}$ per Piece	0	4	4 $\frac{1}{2}$
For three Weeks and two Days Work, for myself, at 3 <i>s.</i> per <i>Diem</i>	3	0	0
For twenty-five Days Work and a half for my Man, at 2 <i>s.</i> 6 <i>d.</i> per <i>Diem</i>	3	3	9
For a Labourer, twenty-five Days and a half, at 1 <i>s.</i> 8 <i>d.</i> per <i>Diem</i>	1	18	0
Their Sum Total is	30	12	5 $\frac{1}{2}$

But if Bricklayers do not work by the Day, then they write their Bills after another Manner: For then they either undertake the Work by the Great, *viz.* to do all, and to find all the Materials blonging to *Bricklayer's-Work*; or else they are to do it by Measure, and to do all the Work, and to find all the Materials, at such a Price, by the Rod, for Walling; by the Square for Tiling; and by the Yard, for Paving, &c.

But if the *Bricklayer* does not find any Materials, he may then work by Measure; and in this Case, his Bill may be made after the following Manner, *viz.* For so many Rods of Walling, at so much *per* Rod, &c. according as he has made his Agreement.

Sometimes Chimney-Work is agreed for with the *Bricklayer* by the Hearth; either only to find the Workmanship, or that and Materials too; and in this Case, the Bill is made according to the Agreement.

There are likewise other Things which come into a *Bricklayer's* Bill, *viz.* all kind of Ornamental Work in Brick; which is usually set down and rated at so much *per* Foot, or at so much *per* Piece. Or there may be a Sum of Money allow'd over and above the Price or Value of the Rod-Work; and then the Ornamental Work will be included in it.

You are to understand by Ornamental Work, Arches, either Straight or Circular, over Windows

B R

dows or Doors ; Fascia's, either with, or without Moldings ; Architraves, Round Windows, or Rubb'd Returns, Friezes, Cornices of all Sorts, Water-Tables wrought, and Water-Courses : All which are valued by the Foot, running Measure.

To these may be added Base-Mouldings and Plinths, and the Splaying of the Jaumbs of Windows and Doors on the Inside of Buildings.

Also Pilasters, Peers, Pediments, Grotto's, and Rustick Quoins.

These five last mention'd are valued at so much *per Piece*, according to the Largeness and Goodness of the Work and Materials. And thus all ornamental Work ought to be valu'd.

By ornamental Work, in *Brick-layer's Work*, is to be understood, all kind of Brick-Work hew'd with an Ax, or rubb'd on a Rubbing-Stone, or of Stone wrought with Chissels, or rubbed with Stones or Cards : All such is ornamental Work, and ought to be paid for besides the Rod-Work.

BRICK-WORK, as to the measuring, &c.] 1. Sometimes Brick-Walls are wrought Part of the Way two Inches thinner than the rest of the Work, which two Inches serve for a Water-Table to the Wall, which is commonly set off about two Foot above the Ground ; and therefore the *Brick-Work* may be measured at the same Thickness, which is above the Water-Table, and then the Two-Inch Work may be measured, as follows :

B R

After the Dimensions of the Wall have been taken, (from the Bottom to the Height, that it is to be taken at two Bricks,) then add twenty Feet in Length, by the Height of the Two-Inch Work, *viz.* from the Bottom or Setting-off of the Water-Table, the Half which is so much Four-Inch Work ; and afterwards reduce that to a Brick and half Work.

2. As to the measuring of Gable-Ends, in *Brick-Work*, that is to be done after the same Manner that Carpenters measure their Gables, (saying that this is reduced to Rod-Work.) See GABLE-END.

3. Be sure to take Notice in taking Dimensions of Walls which join to an Angle, that the Length of one Wall be taken on the Outside of the Angle, and the other's Length to the Inside of the Angle.

4. If there is a Gable-End to measure, and the Breadth of the House be given, (or known which is the Base of the Gable-End, and the Length of the Perpendicular is required,) Measurers have a short Way of finding it ; which that I may render the plainer, I shall give the following Example :

Suppose the Base of the Gable be twenty-four Foot, and the Length of the Perpendicular be requir'd ; take the Length of the Rafter, (which will be eighteen Feet,) and add to it half of itself, which is nine Feet, and it will make twenty-seven Foot, the Half of which is thirteen Feet six Inches, the Length of the Perpendicular.

But

But though this Way is commonly practised, yet it is not exact; for it makes the Perpendicular a little too much.

This, indeed, is practised in Roofs that are three Quarters pitch; but will not be exactly true in any other.

But there are two other Ways of finding the Perpendicular, which are exact: The First is by Proportion, *viz.* as 30 to 22. 35. so is the Length of the Rafter to the Perpendicular required; or subtract the Square of one half of the Base, or one half of the Breadth of the House, from the Square of the Length of the Rafter, and there will remain a Number, the square Root of which is the Length of the Perpendicular.

5. If any Deductions for Doors, Windows, &c. are to be taken out in *Brick-Work* of two Bricks, or two Bricks and a half thick, then add one Third to the Lengths of Doors or Windows in two Bricks, or two Thirds to the Length; for those of the two and a half *Brick-Work*, (or it may be two Thirds, or one Third to the Breadth, and not the Length, according as which will be soonest or easiest divided;) and the Lengths and Breadths being afterwards multiply'd one into the other, the Product will be the proper Directions in a Brick and half Work, without any farther Trouble; and neither Master nor Workman, will be wrong'd.

A TABLE, Shewing by Inspection the Price of any Number of odd Feet of BRICK-WORK, (or other, perform'd by the Rod,) calculated from one Foot to thirty-four Feet, (or half a quarter of a Rod,) and at any Price from 1 s. to 10 l.

B R

B R

The Price of any Number of Feet under 34, or half quarter of a Rod.

Price of the	Rod			2s. 6d.			5s.			10s.		
	$\frac{3}{4}$	Rod	1s.	1s. 10d. 2q.			3s. 9d.			7s. 6d.		
	$\frac{1}{2}$	Rod	6d.	1s. 3d.			2s. 6d.			5s.		
	$\frac{1}{4}$	Rod	3d.	7d. 2q.			1s. 3d.			2s. 6d.		
	$\frac{1}{8}$	Rod	1d. 2q.	3d. 3q.			7d. 2q.			1s. 3d.		
			s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.	s. d. q.
1				0	0	0	0	0	0	0	0	1
2				0	0	0	0	0	1	0	0	3
3				0	0	1	0	0	2	0	1	1
4				0	0	1	0	0	3	0	1	1
5				0	0	1	0	0	3	0	1	3
6				0	0	2	0	1	0	0	2	1
7				0	0	2	0	1	1	0	2	3
8				0	0	3	0	1	2	0	3	0
9				0	0	3	0	1	3	0	3	2
10				0	1	0	0	2	0	0	4	0
11				0	1	0	0	2	1	0	4	2
12				0	1	1	0	2	2	0	5	0
13				0	1	1	0	2	2	0	5	1
14				0	1	1	0	2	3	0	5	3
15				0	1	2	0	3	0	0	6	1
16				0	1	2	0	3	1	0	6	3
17				0	1	2	0	3	2	0	7	0
18				0	1	3	0	3	2	0	7	2
19				0	1	3	0	3	3	0	7	0
20				0	2	0	0	4	1	0	8	2
21				0	2	0	0	4	1	0	9	0
22				0	2	1	0	4	2	0	9	1
23				0	2	1	0	4	3	0	9	3
24				0	2	2	0	5	0	0	10	1
25				0	2	2	0	5	1	0	10	3
26				0	2	3	0	5	2	0	11	0
27				0	2	3	0	5	3	0	11	3
28				0	3	0	0	6	0	1	0	0
29				0	3	0	0	6	1	1	0	2
30				0	3	1	0	6	2	1	1	0
31				0	3	1	0	6	3	1	1	2
32				0	3	2	0	7	0	1	1	3
33				0	3	2	0	7	1	1	2	1

B R

B R

The Price of any Number of Feet under 34, or half quarter of a Rod.

Price of the	Rod			Rod			Rod			Rod			
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	20s.			30s.			40s.		50s.	
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	Rod	15s.		22s.	6d.		30s.		37s.	6d.
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	Rod	10s.		15s.			20s.		25s.	
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	Rod	5s.		7s.	6d.		10s.		12s.	6d.
	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	Rod	2s.	6d.	3s.	9d.		5s.		6s.	3d.
	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.	
1	0	0	3	0	1	0	0	1	2	0	1	3	
2	0	1	2	0	2	1	0	3	0	0	3	3	
3	0	2	1	0	3	2	0	4	2	0	5	3	
4	0	2	3	0	4	0	0	5	2	0	6	3	
5	0	3	3	0	5	2	0	7	2	0	9	1	
6	0	4	2	0	6	3	0	9	0	0	11	1	
7	0	5	2	0	8	1	0	11	0	1	1	0	
8	0	6	1	0	9	1	1	0	2	1	3	2	
9	0	7	1	0	10	3	1	2	2	1	6	0	
10	0	8	0	1	0	0	1	4	0	1	8	0	
11	0	9	0	1	1	2	1	6	0	1	10	2	
12	0	10	0	1	3	0	1	8	0	2	1	0	
13	0	10	3	1	4	0	1	9	2	2	2	3	
14	0	11	2	1	5	1	1	11	0	2	4	3	
15	1	0	2	1	6	3	2	1	0	2	7	1	
16	1	1	2	1	8	1	2	3	0	3	9	3	
17	1	2	1	1	9	1	2	4	2	2	11	2	
18	1	3	1	1	10	3	2	6	2	3	2	0	
19	1	4	0	1	11	0	2	8	0	3	3	0	
20	1	5	0	2	1	2	2	10	0	3	6	2	
21	1	6	0	2	3	0	3	0	0	3	9	0	
22	1	6	3	2	4	0	3	1	2	3	10	3	
23	1	7	2	2	5	1	3	3	0	4	0	3	
24	1	8	2	2	6	3	3	5	0	4	3	1	
25	1	9	1	2	8	0	3	6	2	4	5	1	
26	1	10	1	2	9	1	3	8	2	4	7	2	
27	1	11	1	2	11	0	3	10	2	4	10	1	
28	2	0	0	3	0	0	4	0	0	5	0	0	
29	2	1	0	3	1	2	4	2	0	5	2	2	
30	2	1	3	3	2	3	4	3	2	5	4	2	
31	2	2	3	3	4	1	4	5	2	5	7	0	
32	2	3	2	3	5	1	4	7	0	5	8	3	
33	2	4	2	3	6	3	4	9	0	5	11	1	

B R

R B

The Price of any Number of Feet under 34, or half a quarter of a Rod.

Price of the	Rod			4l. s. d.			5l. s. d.			10l. s. d.		
	Rod			3			3 15			7 10		
	Rod			1 10			2 10			5		
	Rod			0 15			1 5			2 10		
	Rod			0 7 6			0 12 6			1 5		
	l.	s.	d.	l.	s.	d.	l.	s.	d.	l.	s.	d. q.
1	0	2	1	0	2	0	0	3	3	0	0	7 2
2	0	4	2	0	6	0	0	7	2	0	1	3 0
3	0	6	3	0	9	0	0	11	1	0	1	10 2
4	0	8	1	0	11	0	1	1	3	0	2	3 2
5	0	11	1	1	3	0	1	6	3	0	3	1 2
6	1	1	2	1	6	0	1	10	2	0	3	8 0
7	1	4	2	1	10	0	2	3	2	0	4	7 0
8	1	6	3	2	1	0	2	7	1	0	5	2 2
9	1	9	3	2	5	0	3	0	1	0	6	0 2
10	2	0	0	2	8	0	3	4	0	0	6	8 0
11	2	3	0	3	0	0	3	9	0	0	7	6 0
12	2	6	0	3	4	0	4	2	0	0	8	4 0
13	2	8	1	3	7	0	4	5	3	0	8	11 0
14	2	10	2	3	10	0	4	9	2	0	9	6 0
15	3	1	2	4	2	0	5	2	2	0	10	5 0
16	3	4	2	4	6	0	5	7	2	0	11	2 0
17	3	6	3	4	9	0	5	11	2	0	11	10 2
18	3	9	3	5	1	0	6	4	1	0	12	8 2
19	4	0	0	5	4	0	6	8	0	0	13	4 0
20	4	3	0	5	8	0	7	1	0	0	14	2 0
21	4	6	0	6	0	0	7	6	0	0	15	0 0
22	4	8	1	6	3	0	7	9	3	0	15	7 2
23	4	10	2	6	6	0	8	1	2	0	16	3 0
24	5	1	2	6	10	0	8	6	2	0	17	0 0
25	5	3	3	7	1	0	8	10	1	0	17	8 2
26	5	6	3	7	5	0	9	3	1	0	18	6 2
27	5	9	3	7	9	0	9	8	1	0	19	4 2
28	6	0	0	8	0	0	10	0	0	0	1	0 0 0
29	6	3	0	8	4	0	10	5	0	0	1	0 10 0
30	6	5	1	8	7	0	10	8	3	1	1	5 2
31	6	8	1	8	11	0	11	1	3	1	2	3 2
32	6	10	2	9	2	0	11	5	2	1	2	11 0
33	7	1	2	9	6	0	11	10	2	1	3	9 0

*The Explanation of the preceding
TABLE.*

First, At the Head of the Table, over each Column, is the Price of one Rod, three quarters of a Rod, half a Rod, a quarter, and half a quarter of a Rod.

Secondly, In the first Column is the Number of odd Feet, from one descending to thirty-three; and against these odd Feet, in the other Columns, stands the Price or Value which the odd Feet

come to, at the several Rates over each Column.

The Method of using it is as follows:

Find the Price *per Rod* agreed on in the Head of the Tables, and just under it you have the Price of three quarters, half, a quarter, and half-quarter; and under them, in the same Columns, you will find the Price of any Number of odd Feet from one to thirty-four, or one Eighth of a Rod:

E X A M P L E I.

At 5 l. the Rod, what is the Value of three quarters, an half, a quarter, and half-quarter of a Rod, and thirty-three Feet?

	<i>l.</i>	<i>s.</i>	<i>d.</i>
The Price of the whole Rod is — — —	5	0	0
The three quarters is — — —	3	15	0
The half is — — —	2	10	0
The quarter is — — —	1	5	0
The half quarter is — — —	0	12	6
The thirty-three Feet is — — —	0	11	10½
The Sum is — — —	13	14	04½

E X A M P L E II.

At 2 l. 10 s. per Rod, what comes thirty Feet to?

Look at the Head of the Table for 50 s. and you will find 5 s. 4 d. ½; which is the Price of 30 Feet, at 50 s. per Rod.

E X A M P L E III.

What comes 25 Feet to, at 4 l. 15 s. per Rod?

Because you cannot find 4 l. 15 s. at the Top of the Table, therefore first find out what 25 Feet comes to at 4 l. per Rod, which will be 7 s. and 1 d. next find what 25 Feet comes to at 10 s. per Rod, which is 10 d. ¼; and in the next Place, what 25 Feet comes to at 5 s. per Rod, which is 5 d. ¼.

B R

B R

Set them down as follows:

		<i>l.</i>	<i>s.</i>	<i>d.</i>
25 Feet at 4 <i>l.</i> per Rod is	_____	0	7	1
25 Feet at 10 <i>s.</i> per Rod is	_____	0	0	10 $\frac{1}{2}$
25 Feet at 5 <i>s.</i> per Rod is	_____	0	0	5 $\frac{1}{4}$
The Sum is	_____	0	8	5

E X A M P L E IV.

*What comes 29 Feet to at 7*l.* 10*s.* per Rod?*

		<i>l.</i>	<i>s.</i>	<i>d.</i>
29 Feet at 5 <i>l.</i> per Rod is	_____	0	10	5
29 Feet at 2 <i>l.</i> 10 <i>s.</i> per Rod is	_____	0	5	2 $\frac{1}{2}$
The Sum is	_____	0	15	7 $\frac{1}{2}$

E X A M P L E V.

*What comes 32 Feet to at 6*l.* 17*s.* 6*d.* per Rod?*

		<i>l.</i>	<i>s.</i>	<i>d.</i>
32 Feet at 5 <i>l.</i> per Rod is	_____	0	11	10 $\frac{1}{2}$
32 Feet at 1 <i>l.</i> per Rod is	_____	0	2	3 $\frac{1}{2}$
32 Feet at 10 <i>s.</i> per Rod is	_____	0	1	1 $\frac{1}{4}$
32 Feet at 5 <i>s.</i> per Rod is	_____	0	0	7
32 Feet at 2 <i>s.</i> 6 <i>d.</i> per Rod is	_____	0	0	3 $\frac{1}{2}$
The Sum is	_____	0	16	2 $\frac{1}{4}$

A TABLE

B R

B R

A TABLE for reducing *Brick-Work* of any Thickness, to the Standard Thickness of a *Brick* and half.

	$\frac{1}{2}$ Brick.			1 Brick.			$1\frac{1}{2}$ Bricks.			2 Bricks.		
	R.	Q.	F.	R.	Q.	F.	R.	Q.	F.	R.	Q.	F.
1 Quarter	0	0	22	0	0	45	0	1	0	0	1	22
2 Quarters	0	0	45	0	1	22	0	2	0	0	2	45
3 Quarters	0	1	0	0	2	0	0	3	0	1	0	0
Rods contained upon the superficial Measure of the Wall.	1	0	1 22	0	2	45	1	0	0	1	0	22
	2	0	2 45	1	1	22	2	0	0	2	2	45
	3	1	0 0	2	0	0	3	0	0	4	0	0
	4	1	1 22	2	2	45	4	0	0	5	1	22
	5	1	2 45	3	1	22	5	0	0	6	2	45
	6	2	0 0	4	0	0	6	0	0	8	0	0
	7	2	1 22	4	2	45	7	0	0	9	1	22
	8	2	2 45	5	1	22	8	0	0	10	2	45
	9	3	0 0	6	0	0	9	0	0	12	0	0
	10	3	1 22	6	2	45	10	0	0	13	1	22
	11	3	2 45	7	1	22	11	0	0	14	2	45
	12	4	0 0	8	0	0	12	0	0	16	0	0
	13	4	1 22	8	2	45	13	0	0	17	1	22
	14	4	2 45	9	1	22	14	0	0	18	2	45
	15	5	0 0	10	0	0	15	0	0	20	0	0
	16	5	1 22	10	2	45	16	0	0	21	1	22
	17	5	2 45	11	1	22	17	0	0	22	2	45
	18	6	0 0	12	0	0	18	0	0	24	0	0
	19	6	1 22	12	2	45	19	0	0	25	1	22
	20	6	2 45	13	1	22	20	0	0	27	2	45
	21	7	0 0	14	0	0	21	0	0	28	0	0

B R

B R

A TABLE for reducing *Brick-Work* of any Thickness, to the Standard Thickness of a *Brick* and half.

	2 Bricks $\frac{1}{2}$.			3 Bricks.			3 Bricks $\frac{1}{2}$.			4 Bricks.		
	R.	Q.	F.	R.	Q.	F.	R.	Q.	F.	R.	Q.	F.
1 Quarter	0	1	45	0	2	0	0	2	22	0	2	45
2 Quarters	0	3	22	1	0	0	1	0	45	1	1	22
3 Quarters	1	1	0	1	2	0	1	3	0	2	0	0
Rods contained upon the superficial Measure of the Wall.	1	1	2 45	2	0	0	2	1	22	2	2	45
	2	3	1 22	4	0	0	4	2	45	5	1	22
	3	5	0 0	6	0	0	7	0	0	8	0	0
	4	6	2 45	8	0	0	9	1	22	10	2	45
	5	8	1 22	10	0	0	11	2	45	12	1	22
	6	10	0 0	12	0	0	14	0	0	16	0	0
	7	11	2 45	14	0	0	16	1	22	18	2	45
	8	13	1 22	16	0	0	18	2	45	21	1	22
	9	15	0 0	18	0	0	21	0	0	24	0	0
	10	16	2 45	20	0	0	23	1	22	26	2	45
	11	18	1 22	22	0	0	25	2	45	29	1	22
	12	20	0 0	24	0	0	28	0	0	32	0	0
	13	21	2 45	26	0	0	30	1	22	34	2	45
	14	23	1 22	28	0	0	32	2	45	37	1	22
	15	25	0 0	30	0	0	35	0	0	40	0	0
	16	26	2 45	32	0	0	37	1	22	42	2	45
	17	28	1 22	34	0	0	39	2	45	45	1	22
	18	30	0 0	36	0	0	42	0	0	48	0	0
	19	31	2 45	38	0	0	44	1	22	50	2	45
	20	33	1 22	40	0	0	46	2	45	53	1	22
	21	35	0 0	42	0	0	49	0	0	56	0	0

B R

B R

A TABLE for reducing *Brick-Work* of any Thickness, to the Standard Thickness of a *Brick* and half.

		4 Bricks $\frac{1}{2}$.			5 Bricks.			5 Bricks $\frac{1}{2}$.		
		R.	Q.	F.	R.	Q.	F.	R.	Q.	F.
1 Quarter		0	3	0	0	3	22	0	3	45
2 Quarters		1	2	0	1	2	45	1	3	22
3 Quarters		2	1	0	2	2	0	2	3	0
Rods contained upon the superficial Measure of the Wall.	1	3	0	0	3	1	22	3	2	45
	2	6	0	0	6	2	45	7	1	22
	3	9	0	0	10	0	0	11	0	0
	4	12	0	0	13	1	22	14	2	45
	5	15	0	0	16	2	45	18	1	22
	6	18	0	0	20	0	0	22	0	0
	7	21	0	0	23	1	22	25	2	45
	8	24	0	0	26	2	45	29	1	22
	9	27	0	0	30	0	0	33	0	0
	10	30	0	0	33	1	22	36	2	45
	11	33	0	0	36	2	45	40	1	22
	12	36	0	0	40	0	0	44	0	0
	13	39	0	0	43	1	22	47	2	45
	14	42	0	0	46	2	45	51	1	22
	15	45	0	0	50	0	0	55	0	0
	16	48	0	0	53	1	22	58	2	45
	17	51	0	0	56	2	43	62	1	22
	18	54	0	0	60	0	0	66	0	0
	19	57	0	0	63	1	22	69	2	45
	20	60	0	0	66	2	45	73	1	22
	21	63	0	0	70	0	0	77	0	0

The Explanation of the TABLE.

At the Head of the Table, is set the Thickness of the Wall, in Bricks and half Bricks, from half a Brick in Thickness, to six Bricks thick.

In the first Column is placed the Number of the Rods contained in any Wall, from one quarter of a Rod to twenty-one Rods; and against those Numbers, in the other Column, stands the Quantity of *Brick-Work*, in Rods, Quarters, and Feet, which a Wall contains of any of these Thicknesses, at the Head of the Table.

EXAMPLE I.

If a Wall upon the Superficies contain twelve Rods, and it be three Bricks and a half in Thickness, how many Rods does that Wall contain of the standard Thickness of a Brick and a half?

Find twelve Rods in the first Column, and under 3 Bricks $\frac{1}{2}$ at the Head of the Table, in the Angle of Meeting, you will find 28 Rods; which is the true Quantity required at the standard Thickness of a Brick and half thick.

EXAMPLE II.

If a Wall be four Bricks and a half thick, and contain upon the Superficies nineteen Rod, how many Rod of Brick-Work are contain'd in that Wall, at the standard Thickness?

Look for nineteen Rod in the first Column, and under 4

Bricks $\frac{1}{2}$ you will find fifty-seven Rod, the Content required.

And the same may be done as to any other Wall.

BRIDGE, a Work of Masonry or Timber, built over a River, Canal, &c. for the Convenience of crossing the same.

To build a *Bridge* of Timber over any Brook, Rill, or small River, which does not exceed forty or fifty Feet in Length, and that without setting any of the Timber down in the Water, which is both a cheap and safe Way, proceed according to the following Directions:

Let the Timber be so jointed, as in some measure to resemble an Arch of Stone or Brick: Let the Joints be well made, and strongly shut together with Cramps and Dogs of Iron.

This *Bridge* must be made to rest upon two strong firm Pillars of Wood at each End of the *Bridge*, and both well propped with Spurs or Braces; and there ought to be two good Buttresses of Brick, for these Wooden Pillars and Spurs to stand in, that they may not give way, or slip. When this has been done, the *Bridge* may be planked over and gravelled, and will last a long Time. Sir *Hugh Plat* says this Method has been practised.

Of all the Contrivances that Men have used for facilitating Commerce, says M. *Gautier*, this of building Bridges over Rivers, both small and large, has been none of the least Consequence.

Of all the Bridges that have ever been, if we will give Credit

dit to History, it is agreed, that the *Bridge* built by *Trajan* over the *Danube*, was the most grand, and the finest.

As that River, over which it was built, was very wide, so of Necessity the *Bridge* must be very long: For it was composed of twenty Arches of a hundred and fifty Foot in Height, and their Opening from one Pile or Peer to another, was an hundred and sixty Feet, or about twenty-five Fathom; which makes the Length of the *Bridge* about six hundred Fathom, or about five hundred forty-six Fathom of *Paris* Measure; for the ancient *Roman* Foot is but eleven Inches *Paris* Measure.

The Dimensions of a like Work are almost beyond all the Ideas of the Architects of our Times, if what is said be true. This *Bridge* being finish'd, the *Romans* invaded the *Barbarians* on this Side the *Danube*. *Adrian*, *Trajan's* Successor, afterwards caused it to be demolish'd, to hinder the same People, being vanquish'd, from making use of it in passing the River *Danube*, to carry their Arms into the *Roman* Empire.

The Peers of this fine *Bridge* are still to be seen in the Middle of the *Danube*. It was erected between *Servia* and *Moldavia*, a little above *Nicopolis*. Also among the famous *Bridges* renown'd in History, is reckon'd that of *Darius*, over the *Bosphorus* of *Thrace*; and also that of *Xerxes*, over the *Hellepont*, and of *Pyrrius*.

The *Romans* have still at *Rome*, three very fine *Bridges* over the

River *Tyber*. The Emperor *Adrian* caused the first to be built, which is the *Pont Ælius*, at present called *Pont St. Angelo*, or *Angel's-Bridge*, the finest of all those that are at this Day at *Rome*. It was called the *Bridge Angelo*, on account of an Angel pretended to have been seen at the Entrance of it. It was garnished on the upper Part with a Covering of Brass, supported by forty Pillars of the same.

The second was the *Triumphal Bridge*, of which the Ruins are still to be seen in the River *Tyber*. Over this *Bridge* the Emperors and Consuls used to pass, when they had a Triumph decreed them; which was at that Time adorn'd with all imaginable Art.

The third was the *Pons Æniculensis*, at present called *Sixtus's Bridge*; because Pope *Sixtus IV.* caused it to be rebuilt in the Year 1475. This *Bridge* was antiently built of Marble.

The fourth was that called *Pons Castius*; at present, *St. Bartholomew's-Bridge*; which was re-edify'd in the Time of the Emperor *Vespasian*.

The fifth was that nam'd *Fabricius*, or *Tarpeius*; at present called *Ponte Caspi*, or *Quattro Capi*.

The sixth was the *Senatorian*, or *Palatine Bridge*, now called *Saucta Maria*.

The seventh was the *Pons Horatius* or *Sublicius*, one of the finest *Bridges* of *Rome*, and of which the Ruins are still to be seen in the *Tyber*, and which has not yet been re-edify'd.

I shall relate the Elevation of it, according to the Relation of

an *Italian* Author in his Works concerning the Antiquities of the City of *Rome*.

The Figure of it seems extraordinary and fantastical: To see a second *Bridge* raised over a first, and in a like Work, Columns, and other Ornaments of Architecture over that; so that it appeared more like a Triumphant Arch, or Portico, than a *Bridge*. This *Bridge* was demolished in the Reign of the Emperor *Otho*; but rebuilt by *Antoninus Pius*.

The eighth and last, was that without the City of *Rome*, and about two Miles distant; which was called *Milvius*, in the *Flamian Way*.

Besides these *Roman Bridges*, we have modern ones, who are not without their Merit.

Among those of *France*, may be reckon'd those of *Avignon* of *Saint Esprit*, and of *Lyons* upon the *Rhone*. The first of these is demolish'd; there remaining only some Arches on the Side of *Avignon*.

The second is still subsisting; and may be said to be one of the finest *Bridges* in the Universe. One Thing particular in these three *Bridges*, is, That their Plan is not in a Straight Line; especially those of *Avignon* and *Saint Esprit*.

The Angle is little sensible in that of *Lyons*; but nevertheless perceivable; and is on the upper Side of the Stream.

But as for the two preceding, it is certain, that they have an Angle, or a sort of Bending, the Convexity of which opposes the Waters of the *Rhone*, as though being by this Disposition centred,

and are bouted, the better to resist the Weight and Current of the Waters.

The *Bridge* of *Avignon* was composed of eighteen Arches, in Length one thousand three hundred and forty Paces, making about five hundred Fathom. It was begun in the Year 1176, and finish'd in 1188.

The Schism between *Benedict* and *Boniface* was fatal to it in the Year 1385; but a greater Calamity happen'd to it in the Year 1602; by the Negligence of repairing, one Arch fallen down, which caused the Fall of three others. In fine, in the Year 1670, the Cold was so violent, that the *Rhone* was frozen so as to bear Waggon's with the heaviest Loads for several Weeks; and upon the Thaw happening, such Mountains of Ice dashed against the Piers, as shook them, and caused several Arches to fall down.

But nevertheless, the third Pile on *Avignon* Side, with the Chapel of *St. Nicholas* built upon it, has always born up against all Accidents.

Pont Saint Esprit is finer and more bold than that of *Lyons*, or *Avignon*: It consists of nineteen great Arches, besides seven smaller ones. It has Arches from fifteen to twenty Fathoms, opening, rather more than less, which make the Length of the *Bridge* upwards of four hundred Fathoms.

The *Bridge* of *Lyons*, upon the *Rhone*, has twenty Arches. It is observed further of these *Bridges*, that they are defended by Towers to secure the Passages.

Among

Among the fine *Bridges* of *France*, are reckon'd the *Pont Royal* of the *Thuilleries*, that of *Toulouſe* upon the *Garonne*, and one Arch of *Pont-Neuf* at *Paris*.

I ſhall now quit *France*, and paſs over to *England*, and take a View of *London-Bridge*.

London Bridge was begun in the Reign of *Henry II.* in the Year 1176, and finiſh'd in the Reign of King *John* in the Year 1209. Since that Time, it has been divers Times burnt, and ruin'd by Ice, and as often repair'd, or rebuilt. The King and the City contributed to the Charge. This *Bridge* is made of hewn Stone: It has nineteen Arches of a hundred and twenty-five Fathoms *Paris* Meaſure, or eight hundred Feet long, and thirty or twenty-eight Feet and one Eighth broad. Some ſay ſixty or fifty-seven Foot one quarter; for the *London* Foot is fourteen Sixteenths of that of *Paris*. In Height, on the two Sides of the *Bridge*, are built two Rows of ſtately Houſes; and a conſiderable Fund is ſettled for the maintaining it. This *Bridge* is continually beaten and overflow'd by the Flux and Reflux of the Tide. Large Veſſels, which come up the *Thames*, don't go above the *Bridge*; but ſmall ones paſs through it. Its Piers are perfectly well guarded by *Starlings*.

If we paſs into *Italy*, there we ſhall ſee very fine *Bridges*. That of *Alexander Farnese*, Duke of *Parma*, is accounted a very fine one.

Palladio gives us many Deſigns of ſeveral fine *Bridges*; and

mentions the greateſt Part of thoſe which the *Romans* built; as that of *Rimini* in the *Flaminian Way*; thoſe of *Vicenza*, upon the *Bachiglione* and the *Rerone*. He gives us two *Bridges* of Stone, of his own Invention; which are very fine: But upon which he does not pretend that Carriages may paſs, it being compoſed of Lodges, many Streets, Porticoes, Pediments, ſupporting Statues of of Marble, or Braſs, for the finiſhing of the Work.

There is alſo a very fine *Bridge* at *Madrid*, hard by one of the City Gates, called the *Bridge of Segovia*, on the River *Manzaneres*.

In the Relations of the *Levant*, by *Poulet*, there is mention made of one ſingle Arch in the little City of *Munſter*, upon the *Narante* in *Botnia*, a Building infinitely more bold than that of the *Rialto* at *Venice*: which is alſo one ſingle Arch; and paſſes for a Maſter-Piece of Art, built in 1591. the Deſign of *Michael Angelo*; and one Part of an Arch, which is upwards of thirty-two Fathom at the Baſe.

There is no City in the World that has ſo many *Bridges* as that of *Venice*; which are to the Number of three hundred and thirty-nine.

One of the Things which impoſes moſt upon a Man, is a ſtately *Bridge* over a large River: The Boldneſs of huge Arches compoſed of an infinite Number of ſmall Materials, either Stones, or Bricks, ſo firmly united together, that they at laſt ſeem to form but one Piece, and by their Weight afford a ſafe Paſſage to Men, and all heavy Carriages, in
the

passing Brooks, and the largest and most rapid Rivers.

Men have invented many different Sorts of *Bridges*, and they are made after many different Manners, according to the Situation of the Places, the Necessity, and the Materials employ'd. They are for the most part of Stone in some Places, and of Capentry in others, according as they have the Convenience of Stones for the first, and of Wood for the latter.

Palladio is the only Person who has treated any Thing largely of *Bridges*; and what he says in general, is reduced to the giving us to understand, that *Bridges* are the principal Parts of a Way.

That it is surprizing to see that they form properly a Way upon the Water; and that the Properties of a *Bridge* are,

- I. That they be well design'd.
- II. Commodious.
- III. Durable.
- IV. Well-adorn'd.

Bridges are well-design'd, when they are placed over a River, upon the Square, and not slanting; and are well laid out by a Line.

Bridges are commodious, when they are upon a Level upon the grand Highway that abuts upon them; when the Ramps or Ascents be easy and Imperceptible, and the Way broad.

They are durable, when they have good Foundations, and are built according to Art with good Materials:

And they are well-adorn'd when they are decorated accord-

ing to the Rules of good Taste in Architecture; which are agreeable to those Rustick Works, and clouter and heavy Masses of Masonry, with which *Bridges* are built.

Palladio goes farther, and gives Precepts, but such as have no Place in all Sorts of *Bridges*, so as to be a general Rule.

A Man must often conform to the Situation of Places and Circumstances in erecting *Bridges*. Some Difficulties are to be met with. Whereas *Palladio* directs, That in order to build a *Bridge*,

First, To make choice of that Place in a River that has the least Depth of Water, to the End that it may be lasting; and that the Foundation may be even and firm, as Rock and Gravel-Stone.

Secondly, That those Places be avoided, where the Water turning, makes Vortexes or Whirl-Pools, and where the Bottom is soft Sand or Gravel; because these Matters are easily carry'd away by the Violence of great Waters, which commonly alter the Bed of a River, and sap the Foundation of the Piers, and are often the Occasion of the Ruin of *Bridges*.

Thirdly, and *Lastly*, The Stream of the Water must be straight, and without Elbows or Sinuofities in the Banks; because these Turnings and Windings will come in Time to be destroy'd by the Force of the Current, and the *Bridges* will become insulated, and without Epaulments; and besides, that there will be amass'd in these Places a thousand filthy Things which the Ri-

ver will carry thither ; which being stopp'd by the Piers, will at last choak up the Opening of the *Bridge*.

All these Difficulties which *Palladio* mentions often, happen to be in a Place where one would project a *Bridge* ; and it is the Address of an Artist to surmount them by Art.

The *Bridge* called *Pont-Neuf*, and that of the *Tuileries*, had never been erected in the Places where they are, if all these could have been had : But when one can have his Choice, it will be very well to follow *Palladio's* Advice.

This Author, besides, says that there are two Sorts of *Bridges* ; the one made of Wood, and the other of Stone.

That which is erected over the Torrent called *Gismone* at the Foot of the *Alpes*, between the Cities of *Tredit* and *Bassane* in *Italy*, is form'd by six equal Bays of Joists, and carried up entirely to the Length of near seventeen Fathom, between the Abutments built upon the Brinks of the River. *Fig. I. Plate I.*

The Joists lying along upon the Beams, and being cover'd, make the Planking or Flooring and Way of the *Bridge*. See the *Figures*.

Palladio says, that there is no *Bridge* made after the second Manner. See *Plate I. Fig. II.* Although we are assur'd there is one in *Germany*. And in Effect, *M. Blondel*, who relates all that *Palladio* has said, assures us, that he has seen the like at *Nerva*, a City belonging to the King of *Sweden*, in the Gulf of *Finland*, in the *Baltick-Sea*.

The Assemblage of the Third, is that of a Scheme-Arch. The Divisions are unequal in Number ; and it has at each End a long Brace at the End below, in the Wall of the Abutment.

The Fourth Figure is in the Form of a Vault, or Mold for an Arch ; and the Assemblages between the two Poinçons are disposed after the Manner of Vouffoirs. The Divisions are in Number unequal, that there may be one Vouffoir in the Middle, serving as a Key.

Says *M. Blondel*, if there were another Assemblage equal to that of the *Bridge* underneath it, the Work would be infinitely stronger.

Upon this Notion, it was projected, to make a *Bridge* cross the River *Seine*, overagainst the *Seine*, above *St. Cloud*, to abridge the Way of *Versailles*.

As to *Stone-Bridges*, *Palladio* observes four Things :

I. As to the Heads of *Bridges*, or their Abutments.

II. As to the Piers.

III. As to the Arcades.

IV. As to the Pavement upon the Arcades.

The Abutments ought to be very solid, and to be made on such Places of the Rivers that are rocky, hard Gravel, or good Ground ; otherwise, they must be secured by Art, with other Piers, or other Arches.

The Piers ought to be equal in Number, to the End that there may be one Arch in the Middle, where commonly the Water has the greatest Current ; which renders the Work stronger, more equal,

equal, and more agreeable to the Sight ; the Foundations ought to be laid at that Time of the Year, during which the Waters are at the lowest, as in Autumn : And if the Foundation is rocky, hard Gravel, or Stony Ground, the first Stones of the Foundation may be laid without hollowing or digging any deeper.

But if it be soft Sand, or Gravel, then it will be proper to carry it off, till you come to find a solid or firm Bottom ; or, if this be too difficult, you must at least carry off one Part of it, and pile the rest. But in the first Place, the Side of the River where you are to work, must be inclos'd in Dams ; and the Current must have its Liberty on the other Side.

As to the Piers, they ought not to be less in Bigness than one sixth Part of the Breadth of the Arcade ; nor commonly more than a Fourth. Their Structure ought to be large good Stones well joined together with Cramps of Iron, or other Metal ; to the End that by this Enchainment, they may be as one entire Stone.

It has been a Custom to make Advances or Projectures at the End of Piers, at Right Angles ; and sometimes in Semicircles, the better to throw off the Water, and to resist the Shocks of Trees or other Things, which the River carries when it is large,

Thirdly, The Arches ought to be made of very long Stones, and well jointed. Those are the strongest, that are semicircular ; because they bear entirely upon the Piers, without pushing the one against the other.

When one is constrain'd by the too great Height, the Arches may be diminish'd, or made Sheme-Arches ; so that the perpendicular Height upon the Line of their Chord may be one Third of the same Chord ; in which Case, the Abutments must be extremely well fortify'd.

After this, *Palladio* gives the Designs of some antique *Bridges*, or of his own Invention.

The first is that of *Rimini*, built by *Augustus*, over a River twenty-nine Fathoms broad, made with five Arches ; the three middlemost are equal, and each twenty-five Feet ; and the two others, but twenty Feet ; the Abutments are each seven Foot and a half ; the Piers are eleven Feet ; and the Arches semicircular.

The Projecture of the Piles rises no higher than the Imposts, above which are Tabernacles and Niches for placing of Statues. The whole Length of the Work is crown'd with a Cornice ; and above that, a Parapet, adorn'd from its Zocle, its Base, and Cornice, with *Tuscan* and massive Work.

He afterwards gives the Description of the *Bridge* over the *Bachiglione*, of sixteen Fathoms wide, compos'd of three Arches, each twenty-two Foot and a half ; the Abutments, two Foot and a half in Breadth, and the Piers five Feet.

The Arches are Scheme ones ; and their Height is one Third of the same Chord, as well the middle Arch, as the other two.

He also gives an Account of the *Bridge* of *Rerone*, whose River is sixteen Fathoms wide. The
Bridge

Bridge is compos'd of three Arches; that in the Middle, being twenty-nine Feet; and the other two, twenty-five each; the Abutments of which, are but three Foot and a half, and the Piers, five Feet; their Projecture, at Right Angles; the Arcades are Scheme ones.

Palladio also gives the Design of a *Bridge* after his own Manner, over a River thirty Fathoms wide, between the Brinks of the River and the Abutments, which consists of but three Arches; that in the Middle, being ten Fathoms, and the two others, eight apiece; the Piers two Fathoms, or one Fifth of the Breadth of the great Arch.

The Arches are Scheme ones, and their perpendicular Height above the Imposts is one Third of their Breadth.

Leon Baptista Albert tells us, that the Parts of a *Bridge*, are the Piers and Arches; and the Pavement above the upper Part of the *Bridge* has a large Way for the Passage of Cattle and Waggon; and little Banks on each Side, for the Convenience of Foot Passengers, inclos'd on the Outside by their Breast-Works, or Parapets.

In some Places, he says, *Bridges* are cover'd, as anciently *Adrian's Bridge* at *Rome* was, now call'd *Pont St. Angelo*, which was the finest and most magnificent of them all; the Ruins of which cannot be beheld without Veneration.

As for the Structure of a *Bridge*, he says, it must be allow'd the same Breadth as the grand Highway that abuts upon

it: That the Piers ought to be equal in Number and Size. Their Breadth should be one Third of that of the Opening of the Arch. That there must be before the Piers Juttings-out in the Form of the Prows of Gallies, against the Current of the Water; which Juttings-out, in their Projecture, must have one half of the Breadth of the Pier itself; and which must be rais'd above the greatest Heights that the Water rises; and that there must be made on the other Side, others in Form of Pous; which will not be disagreeable, if their Points are cut off, and made more blunt than the other.

He says, it will not be amiss, if on the Right of the Juttings-out, there be Counterforts on each Side, or Pilasters reaching up the Height of the *Bridge*, the better to sustain the Flanks; and their Breadth below, not to be less than two Thirds of that of the Pier; the Impost of the Arch ought to be entirely out of the Water: The Ornaments of the *Ionick* or rather *Dorick* Architecture.

Serlio tells us, that at *Pont Sixtus*, the Piers have one Third of the Breadth of the great Arches; the greatest Arch but half a Circle of Height of one Sixteenth of the Diameter.

At *Pont St. Angelo*, the Piers are one half of the great Arch, and is semicircular; the Bandeau, or Head-Band, the Height of one Ninth of the Diameter of the Arch; the Piers bear upon a grand Base, or Pattern of the Pillar, in Form of a Zocle quartered, rais'd some Feet above the ordinat

ordinary Level of the Water, by a Projecture on the Outside, round the whole Pier.

Its Spur, or Counterfort, is a Semicircle, which rises to the Middle of the Arch; a square Pilaster above its Parapet, with Pedestals at equal Distances; which serve to sustain, according to the Opinion of *Albertus*, the forty-two Columns which support the Covering of the *Bridge*, the Arches being semicircular.

The *Bridge de Quatro Capi*, anciently *Fabricius*; of which the Author relates, that there are but two Arches remaining, which are equal and semicircular, have a Pier the Breadth of the Arch, with a Spur, or Counterfort, round it, and a Niche above. The *Bandeau* of the Arch is rustick, and its greatest Height is one Tenth of the Breadth of the Arch.

Pont Milvius has semicircular Arches, born upon Imposts of the Height of one Third of their Diameter; the Piers are half the Breadth; and upon them, there are Niches without Ornaments.

M. *Blondel*, of the *Royal Academy of Sciences*, an accomplished Man, caused to be built at *Xaintes*, upon the *Charente*, near the Place where the Ebb of the Tide commences, a *Bridge* of Stone, in the Year 1665; the Piers of this *Bridge* are in Proportion, at 3 to 8, as to the Breadth compar'd with the Opening of the Arches; the Pier at the End, towards the *Pont Lewis*, and which serves for an Abutment, has one Sixth of the greatest Width; because it is to sustain on that Side the Push of

all the Arches, (which are Scheme ones,) in order to carry the Height of the Imposts above the common Height of the Waters of the River, without making any Alteration of the Level of the old *Bridge*.

This is in a Manner the Substance of what the most celebrated Architects have given us in writing, as to the Proportion of *Bridges*; but no body has given us as yet the demonstrative Reasons: They have not acquainted us with the Fufts of their Column; what Measures we shall give either to the one or the other; which may be helpful to us in imitating them: They have given us no Reason why they do after that Manner, rather than any other.

The ablest Architects are not agreed among themselves as to the Proportions they give to Buildings, not only as to their Solidity, but even not in respect to their Ornaments.

So true it is, That Arts and Sciences are still imperfect. All these depend upon a certain Taste and certain Ideas that Men have had different from one another, and in different Ages. So many Architect, so many different Manners.

It may be seen, as to all that has been before related, they give us no Reason why they make their Piers, their Abutments, their Arches, &c. of such a Largeness, or such a Thickness; and those who now work according to these ancient Examples, know no more than the Authors themselves, for what Reasons they do so.

The

They conduct themselves only by Ideas that they cannot demonstrate ; but which appear to be imitable, by the Example of so many others who have succeeded otherwise ; for which Reasons they say the Work is beautiful and solid, because the Proportions between the Parts which compose it, are there observ'd.

Although I have made a diligent Search into this Affair, says M. *Gautier*, I have not found what has satisfy'd me.

It were to be wish'd that some accomplish'd Person would set himself upon the solving of these Difficulties, in order to render them easy to the Publick.

M. *De la Hire*, of the *Royal Academy of Sciences*, has labour'd for this Purpose ; but those who are not so learned as himself, cannot comprehend him, for want of being acquainted with *Algebra*, he having express'd himself in Terms drawn from this Science ; which, Workmen, and Persons of but a moderate Share of Learning, know little or nothing of, and consequently understand not how to be profited by them.

Of the Projection of Bridges.

The *Sieur Gautier*, Architect, Engineer, and Inspector of the *Bridges* to the *French King*, says, in his *Traité des Ponts*, there are so many Things to be known in relation the building of *Bridges*, either of *Carpentry*, or *Masonry*, that it is hard to find one Man that is equally qualified with the Knowledge of them all.

And it is sufficient in a Work of Consequence, if many Persons can be found, who all of them together, understand well what is best to be done.

A Carpenter or Mason of Experience, cannot be too highly prov'd.

These two Persons are ordinarily the Head, the Workmen, the Arms ; and a well accomplish'd Engineer, or Inspector, the Soul of the Work, for either the carrying on, and the ready Execution or good Manner of it. And it is impossible, this Conductor, who shall be an Engineer, Architect, or Inspector, be so fitly qualify'd for that Office, as that he may be depended upon, unless he knows also the working Part.

Nor is it possible, he should know the working Part, if he does not know the Parts and Materials to be used in the Work ; and also the Utensils, Scaffolding, Plummets, Engines for raising great Weights, Pit-Wheels, Pumps, Buckets, &c. for emptying and clearing the Foundations, Dams, &c. of so many different Forms ; the Manner of piling the Foundations, great Borers for boring the Rocks, according to their Consistence ; Centres, or Molds for Arches, Assemblages, the Cut of Stones, and an infinite Number of other Things which cannot be foreseen : So that for the erecting of a considerable *Bridge*, he ought to be a Person of universal Knowledge, and not ignorant of any Thing that relates to the Mystery of Architecture, which supposes the Knowledge of all those

those Things, if he would succeed.

When any one projects a *Bridge*, he ought to begin,

1. With making an exact local Plan; which Plan shall precisely lay down the Extent of the Water, the Sands, (if it has any,) the Banks or Brinks of the River, and the Ways or Streets that abut upon this *Bridge*.

2. He must project upon this Plan the *Bridge* design'd, whether of Masonry, or Carpentry; with the Number of Arches and Quantity of Piles, Bays, or Joists. He must always lay down the *Bridge* over the River upon the Square, and never slanting.

3 He must, upon this Plan, trace a Line which shall cut the *Bridge* in the Middle, and there found the Depth of the Water from Fathom to Fathom, or from two to two, or from three to three, according as there shall be Occasion.

This Sounding is to be made either by a Pole, divided into Feer, at the End of which is a Leaden Weight, according as the Current of the Water shall require.

If this shall not be sufficient, he must make use of a Cannon-Ball, put into a little Bag, tyed to the End of a Cord, which has been before divided into Feet and Fathoms.

He must make use of these, or other Methods, which shall be found to be most proper, according to the Rapidity of the Water that is to be surmounted.

All this is to be done by means of a Boat, which may be conducted in different Manners; either by a Cable, which is carried across the River, or by other

Cords made fast to Trees, or Stakes on the Bank, or to Stakes drove down for that Purpose; round which the cable that is to hold it is to be many Times turned, and slacken'd, according as Occasion requires, to guide the Boat more to one Side than the other.

4. The Soundings of the Water being made, and set down on the Plan, they serve for making a Profile of the River, which marks or sets out the Depth of the Water that has been found; and the Line under the Water, whether it be sandy or rocky, to which Attention must be given, marking the Difference on the Profile.

Upon this Profile is marked by a Line the Depth of the Water, at the lowest it is at any Time of the Year, which the Bridge-Masters of great and navigable Rivers will acquaint you with; and the Peasant or Inhabitants of the neighbouring Places to small Rivers, will inform as to the Height of those Inundations, which have happen'd in their Memory.

There may also be drawn in the Profile, which shall shew the Mean of the Height of the Waters.

All these Lines being drawn by a perfect Level, parallel the one to the other, may be washed with a Water Colour.

5. The Profile being thus rais'd, a Sounding-Iron may be made of a convenient Length, for sounding below the Depth of the Water the Ballast or Sand; and no Certainty can be attained till this is done, and the Depth of the Water be known: And

in order to this, there are two Methods used, either by a Sounding Instrument of Iron, made on purpose, having a large Ring at its Head for a Crowning, cross which there goes the Arm of a Borer, larger or smaller, in order to turn it with; and having at the Top a Head to be driven down; to make it enter till it comes to a firm Bottom below the Sands.

This Sounding-Iron is made pointed and barbed at the End with four Angles; so that being bored or forced through the Sand, or Part of the Rock, or solid Ground; that it meets with below the Sand, by being turned several Times, in order to bring up in the Hollows of the Barbes some small Quantities of the solid Ground it meets with, and thus being drawn up, the Quality of it is to be entered down in the Memorial that is provided for this Purpose, in order to know what kind of Ground the Bottom is.

There are Instruments for sounding of another sort, which have a little Pocket in the Form of a Snail-shell at the End in the Shape of a Borer, which receives nothing but Sand in turning one way, and the Earth under the Sand by turning it the other.

These Sounding Instruments must be all of one Piece, that they may be as strong as may be; sometimes they are adjusted according to the Hardness or Softness of the Ground to be penetrated; sometimes they are of no Use, especially when the Sand is too gross, and meets with Flints that the Sounder cannot remove.

In this Case, they make use of a Stake of Oak made round, of the straightest Piece of a Tree of three, four, five, or six Inches Diameter; which having determin'd to what Depth of the Earth they would sound, they arm with a Lardoir, or pointed Iron at the End, for removing the Flints; with a Ferrel at the Head, to be able to resist the Strokes of a Beetle with two or three Helves, with which the Sounder is driven down.

All this requires a great deal of Pains, Care, and Expence too; but the Satisfaction of doing the Work well, and making a faithful Relation of it on the Profile, of the Depth of the Sand or Gravel that is to be piled, or which ought to be removed for the Foundation of the Piles, in order to settle the Dams necessary, will make amends for them; and so long as a Person is ignorant of this Depth, he can neither project a *Bridge*, nor know how to compute the Expence, since he cannot tell what Timber it will take up, nor what Precautions ought to be taken for securing the Work.

6. When a Knowledge of the Consistence of the Ground has been obtained, as whether Sand, Earth, Rock, &c, then a person may proceed with Safety upon the Profile he has made, to lay down the Projection of the *Bridge*, whether of Masonry or Carpentry; then the Length and Thickness of the Piers and Piles may be known, according as the Foundation must be more or less in Depth.

7. This being done, and the Height of the highest Inundations being known by the Information of the antientest neighbouring Inhabitants, Marks are to be made at this Height; and supposing three Feet upwards to be the Intradosse, or inward Face of the Arches of the Bridge that one would lay down a Projection of, and also the Bays, Joists, Beams, &c. of a *Wooden Bridge*, which is the same: The Work may be so regulated, that it may be known to what Height the greatest Inundation will rise, and to what Depth the Foundation of the Piles, &c. must be carried.

8. The next Thing to be done, is to provide the Materials which are to be employ'd in the Work.

For a Stone Bridge.

It ought to be considered from whence the Free Stone may be had, its Distance, the Easiness or Difficulty of cutting it, its Carriage, its Nature, as to its being strong or weak, in regard to the Effort it is to sustain, being pressed by the Reins of the Arches, if it will be able to sustain the Weight; for there is some Stones so tender, especially having been but lately taken out of the Quarry, as one may say bleeding, that they will crack, split, or shiver to Pieces.

As to the Lime, it is to be considered from whence that is to be had, its Nature, and when it takes hold, whether as soon as it is used, or a long Time after; the Wages of Workmen, the Cheapness and Conveniency of having Provisions, the Conveniency of the Place, and Number of the Workmen required to

finish the Work in a certain Time; before the Rains of Autumn, which make Rivers overflow; and a many Precautions are necessary to be taken, that cannot well be enumerated.

For a Bridge of Carpentry.

The Builder must inform himself from whence the Timber must be had; if it be sound and good; the Time for procuring it; the Charge of it, as to what it will cost, laid down at the Place; what Quantity must be fashion'd for Piles, and what for Centres, Scaffolding, &c. that all the Materials may be ready in Time, to begin the Work without Hindrance, and to be able to finish it before the contrary Seasons for the compleating of the Bridge commence.

The Breadth of Bridges are to be regulated according to the Multitude or Throng of People who pass over them, and the large Streets or Roads that abut upon them: The Height and Breadth of the Arches, according to the Commerce and Navigation of the River.

All these are necessary for the laying down an exact Projection. To these may be added, other Things necessary, according as the Circumstances of the Place shall require, and according to the Discretion of the Master-Builder.

Of the Largeness of Bridges, in Proportion to the Quantity of Water they must receive when Inundations happen.

It has been already said, when any one lays down the Projection of a Bridge, he must inform himself as to the Quantity of Waters

Waters which pass in the River over which the *Bridge* is to be built, in order to make the Arches, the cross Beams, Joists, &c. of a sufficient Largeness, to be able to give them a Currency.

The common Rule is to make the Intradosses of the Arches at the Places of the Keys; and the cross Beams or Joists of the *Bridges* of Carpentry, three Feet higher than the highest Inundations.

This Rule is not observ'd in all the Arches of a *Bridge*, which has many; but it is look'd upon sufficient, if the middlemost be so, and most of the others diminishing, so as to make an easy Ramp above, to gain the Height of the Arch.

There are many *Bridges* which are after this Manner; but the surest Method is to have all the Intradosses of the Arches of the same Height, three Feet or upwards higher than the greatest Inundations, although they be not so wide; made, if you please, by elevating the Beginning of the Centres higher, to hinder the Waters from being forced to pass under them, which causes Hollows, or washes away the Foot of the Piles, and at length throws them up; and too often all the Work, by reason of this Error.

The Piers of *Bridges* do very much diminish the Largeness of the ordinary Bed of Rivers; and this occasions the Waters to be very much pressed in the Arches at the Times of Inundations.

The Rivers then make Hollows among the Piers, and also under the Arches, after such a Manner, that they throw into the Depth

what they have diminished or taken from their Breadth; and this is one of the principal Causes of the Ruin of *Bridges*.

Bridges should never be projected in narrow Places, at least when they cannot be founded on a Rock, and when extraordinary Precautions are not taken.

If one Third of the Breadth of a River be diminished in the making of a *Bridge*, by the Spaces or Compass of the Piers, and this River is but two Fathom deep in this Place when it has its ordinary Course, one may reckon that it acquires one Fathom more in Depth at the Times of Inundations, it having been contracted by reason of the Masonry of the Piers used in it one third Part.

Rivers do neither augment or diminish, but according as it rains more or less. There are some Countries in which it rains more than in another, that is its Neighbour.

The Quantity of Rain that falls at *Paris*, according to *M. de la Hire*, is about nineteen Inches or thereabouts, one Year with another.

M. the Count de Pont Briand, who has made the like Observations in his Castle near *St. Malo*, has found it to be twenty-four Inches six Lines: And *Father Fulchiron*, at *Lyon*, has found it thirty-six Inches nine Lines.

If these three Quantities (very different one from the other) be joined together, there will be a Reduction of twenty-six Inches nine Lines, which falls upon the Surface of the Earth from *Lions* to *St. Malo*, in the Space of a Year.

The Wind, the Sun, the Earth, the Plants, &c. consume a good Part of this Water, and the rest runs down the Declivities of Hills into the Valley, into the Streams, Rivers, and the Sea, and pass under the *Bridges* built over the Rivers.

If one measures upon a good

Map the Extent of Land which amasses all the Waters which flow in a River, over which a *Bridge* is built, we shall find that those which pass in the River *Rhone*, under the *Bridge* of *St. Esprit*, they come from an Extent of Country containing 2800 Leagues square.

Those of the Royal <i>Bridge</i> of <i>Paris</i>	————	1700
Those of the River <i>Tiber</i> at <i>Rome</i>	————	1100
Those of the <i>Rhône</i> at <i>Lyons</i>	————	800
Those of the <i>Garonne</i> at <i>Toulouse</i>	————	440
And those of the <i>Thames</i> at <i>London</i>	————	430

By this Means, upon a Map, one may see the Difference of all Rivers, more or less, and the greater or lesser Quantity of Water that they can furnish, and that passes under the *Bridges*; the Figures of which are given by M. *Gautier*.

If the Extent of square Leagues be cubed, at the Rate of twenty-six Inches nine Lines in Height, we have the Quantity of cubick Fathoms of Water which passes every Year under these *Bridges*, a Deduction being made for what the Sun, Winds, Plants, &c. have not dissipated.

These Remarks may be of Use to a Person who lays down the Projection of a *Bridge*, in order to regulate the Opening of the Arches, larger in one Place than another, in Proportion to the Quantity of Rain that falls more or less in one Place than in another, in regard to the Extent of Land the Rivers run through; but this Calculation ought not to be made but by the Testimony of the most antient Inhabitants of the Country.

Many have been of Opinion, that the Inundations that have happened from Time to Time, were caused by certain Revolutions, and regular Periods, which return, after many Ages, as they did before.

The Example of the Observations which have been made at *Rome* upon the *Tiber*, since the building of this City, which was formerly the Capital of the Universe, and since the Time of its first Kings, confirms the contrary; since it is proved by an Account, and by exact Remarks which have been made of it, that never any Inundation, compared with another which went before, has had any Relation to the Precedent. See what follows.

In the Year of the building of *Rome* 240, the River *Tiber* overflow'd after an extraordinary Manner:

In the Year { 391
563
546
557 it overflow'd twice.
591 twice.

In the Year { 600 } it was like a Deluge
 { 765 } during twice over-
 { 875 } flowing.
 { } this last *Tiber* over-
 { } flow'd twice.

In the Reign of { VESPASIAN.
 { NERVA.
 { ADRIAN.
 { ANTONINUS PIUS.
 { MARCUS AURELIUS.
 { MAURITIUS.

In the Time of the Pontificate of Pope { G. III.
 { GREGORY II.
 { ADRIAN I.
 { NICOLAS I.
 { GREGORY IX.
 { NICOLAS III.
 { URBAN VI. in 1379.
 { MARTIN V.
 { SIXTUS IV.
 { ALEXANDER VI.
 { LEO X.
 { CLEMENT VII.
 { PAUL IV. in 1557.
 { PIUS V. and SIXTUS V. 1589.
 { CLEMENT V. in 1598.

The Water under the Arches of a *Bridge* should never be forced, so as to cause any Disorders or Turbulencies under them, more than they ordinarily have at the Banks of the River within which they ordinarily flow; if there be given to these Arches between the Piers a Passage equal to that the River had in its natural Bed, so that if its Breadth, for Example, were one hundred Fathoms, the Void of the Arches between the Piers and the Abutments should have the like Breadth; to the End, that the Friction or Beating of the Water against the Piers of the *Bridge*,

when built, be equal to that which they made on the Banks of the River before the building of the *Bridge*.

A *Bridge* may be made equal to the Breadth of the River, by making their Abutments to enter the Land beyond the Banks of the River, as much Space as the Piers occupy in its bed, and by that Means rendering the Pressure of the Water under the Arches equal to what they were before the building of the *Bridge*.

Of the Rapidity of Waters under Bridges, and the Means to avoid it.

It is certain, that the Piers of *Bridges* don't become destitute of Gravel, nor oftener fall to Ruin, by any Thing more, than by the Rapidity of those Waters which undermine their Foundations.

If the Current of a River can be diminished, it is certain that the Piles of a *Bridge* will not be in danger of being so often overthrown: And there are but two Ways of lessening the Current of Rivers; the first is by lengthening their Course, in making them circulate in a Plain, if it be possible, and the great Turnings and Windings that they are made to have, diminishing their Declivity, causes them to lose their Force, by Reason of their great Compass.

This is the Means that the Antients made use of, in rendering their Rivers navigable, where the Disposition of the Country would permit it, they being unacquainted with the Art of making Sluices.

But this Method is not practicable in stopping the Course of a River, at a Place where there is Occasion for a *Bridge*.

The second and last Method of diminishing the Course or Current of a River at the Place of a *Bridge*, and which is what the Antients knew nothing of, is by stopping short the Funds of the most rapid Rivers, by Rows of Banks, Stakes, or Piles, which cut the Current of the Water in the Bottom of the Bed, and raise it to what Height one pleases.

Waters augment and diminish in Rivers, in Proportion to their greater or lesser Declivity; which they find in gliding in their Bed, which they hollow or wear by little and little: From the first Ages that they have begun to flow, they hollow them more and more every Day, according to the Force they have of carrying along the Sand and Stones in their Inundations.

All these Bodies descending, rub or wear the Banks of the Rocks, which contain those Rivers, and aggrandize them, or bring them to that Largeness in which we see them at this Day.

It is in common at these rocky Places, where the Rivers are most kept in above, and the most quiet or smooth; and from whence they pass with greater Rapidity, because of their Fall. These Rocks have given Men the Notion, and put them upon imitating them, and rendering Rivers calm and navigable, artificially, by Retentions, so as to make the Waters lose their Rapidity on their Surface, by giving it to them underneath by their Fall, which they have to leap from above the Sluice made by Art. And this is the Method that ought to be used to hinder the washing away of the Foun-

dation of a *Bridge*, when it is not founded very low.

The *Bridge* of *Coursan*, in *Languedoc*, one of the finest *Bridges* in this Province, upon the River *Aude*, in the Diocese of *Narbonne*, has shaken, or fallen by this Default.

Rivers may be made to flow with more or less Rapidity, as they are more or less pent up. I shall explain myself.

When a Projection of a *Bridge* over a River is made, it is certain that the Piers of Masonry, or the Rows of Piles or Stakes that are projected there, diminish the Bed of a River over which a *Bridge* is to be made.

Now supposing this Diminution to be but one Fifth; we may conclude for certain, that when Inundations happen, they will hollow the Bed one fifth Part more than they did before the building of the *Bridge*; because the Waters gain in Depth what they have lost in Breadth.

Again, it is certain that the Bed of a River having been rendered narrower by one Fifth; the Waters which are always the same in Quantity in their Current, from their Sources to the Sea, being divided into three Streams or Rivulets, or re-united into Rivers, pass with greater Quickness by one Fifth, in the Place where they are contracted within a smaller Compass, in order to erect a *Bridge* there, and by Consequence, wash away the Foundation; from whence they have more Hold by one Fifth; and they hurry away with this first Fifth with the greater Quickness, the Flints, &c. and such other Bodies, which they

they had not Force enough to carry along with one Fifth less of their Weight, or the Quickness of their Motion, which I esteem as equal the one to the other. If the Current of an entire River be retrench'd the one half of its whole Length, there is no Doubt but that the Waters which this River contain'd before, would flow with a double Rapidity; and, on the contrary, that they would diminish their Quickness by one half, if they should be enlarged one half more than they were.

For Example: The *Pont Royale*, or the Royal Bridge of the *Thuileries* in *Paris*, over the *Seine*, seventy Fathoms long, its Piles bar the Breadth of the River, diminishing it about one Twelfth; there is no Doubt to be made, but that the Waters pass one Twelfth quicker through the Arches, than they passed before the Bridge was made.

For the same Reason I conclude, that *Pont Neuf*, above that of the *Thuileries*, being, for Example, twice as large as that of the *Thuileries* in the Opening of its Arches; for they have about ninety-six Fathoms void Space in their Length; whereas those of the Bridge of the *Thuileries* have not above fifty-six; the Water of the *Seine*, which passes through both these, at the Time of great Inundations, must pass slower by one half at *Pont Neuf*, than it passes at that of the *Thuileries*.

And, in fine, if the Waters of the *Seine* carried a Flint but of one Pound Weight, under *Pont Neuf*, to the moving of which, they contributed all their Rapid-

ty or Swiftness, and Weight; the same Waters passing under *Pont Royal* of the *Thuileries*, would carry a Flint of two Pound Weight, according to the Proportion of the Greatness of the Opening of the Arches of the one Bridge and the other, and the Retrenchment of the Waters at the Time of their Overflowings.

All these Notions are essential to a Man who projects a Bridge.

If we would examine further the Force Waters have upon Bodies of the same Matter, but of different Bignesses, the Reason will easily be perceived, why they carry away Sand sooner than Ballast; and the latter, than Flints, than great Blocks of Stone, although all composed of one and the same Matter.

And when it shall be known, that the Movement join'd to all these Bodies different in Size, takes such as have the most Surface, in respect to their Weight, that the Ballast, which is the largest, the Water raises rather the first than the last, a Person will not be surprized at all these Effects, and will presently see the Reason of it.

Thus Sand having more Surface, in respect to its Weight, than the Ballast which is larger; the Water raises the first sooner than the last, because it has more Hold of it.

It may be seen by this, that the more Bodies are diminish'd, the more their Surfaces are augmented; which, in respect to the Movement, having scarce any Thing but Surface, and very little of Body, they become so

light, that the least Motion carries them away; as is seen when they are reduced into Dust: And Gold, for Example, being reduced into Leaves, is carried away by the least Puff of Wind.

This, which has been already said, being known, we shall next pass to the other Means used for the building of *Bridges*; which is the lowering of the Waters of the Rivers.

Of Lowering the Waters of Rivers, and the Manner of diverting them, for laying the Foundations of a Bridge.

When it is intended to work upon the Foundations of a *Bridge*, the most proper Season of the Year must be taken for this Work. as the Summer-Time, after the Snow has been all melted.

If the River, in which Piers are to be erected, is situated between two Mountains, and the Course of it cannot be possibly diverted, and carry'd through a Plain, the Architect must content himself with laying the Foundation by fixing first one Pier by Dams, or Water-Stops of Piles, which may direct the Current of the Waters of the River to the opposite Bank, or so that it may run round the Work.

He must render the Waters calm in that Place where he would erect the Piers.

After the Waters of a River have been so diverted, as to have fixed one half of the Piers of the Foundation, then the Current of the Waters are to be turn'd to that Side which has been erected by another Dam, contrary to the first, that has been

demolish'd, in order to finish the other Side of the *Bridge*.

When this has been contriv'd, the Architect must examine if there be any Mill-Dams below, which may raise the Course of the Waters, which he ought to cause to be broken down in the Place of the Bank, or Dam; which will be least prejudicial; or will do the least Damage; and to give the River a Currentcy that Way, to lower the Waters as much as may be.

These Ruptures are made by stripping the Dam or Dike of all its Straightenings, or narrow Passages; and of all those Things that retain the Water in one Place. Where any Opening has been made, there should be nothing left but Piles and Stakes, to be able to be us'd for the shutting in these Openings after the Piers of the *Bridge* have been fixed, and raised higher than the Waters of a Mill-Dam or Pond.

But when the Water of a River, over which you would erect a *Bridge*, may be easily diverted or turn'd off; as when an Island or Islet is to be met with, and that the River may be diverted with one of these Currents; this Facility does infinitely forward the Work: And it is the same, when there happens to be a Plain, where the River has a large Extent; when there is any Inundation, and afterwards retreats again into the former Channel, where it is reduced again to its common Quantity of Waters; then the Foundation of the *Bridge* may be piled the whole Extent of the Plain where the River does not run, when its Waters are at the lowest; and when

when the Foundations of these Spaces are laid, a Canal is made through all that Part which is finish'd, through which, the Current of the Waters may by little and little be deriv'd, by very simple Works, according to the Disposition of the Places, by cutting the Current of the River as deep as may be, and in that Place of its Course where it has least Depth.

As if I have but three Foot Depth of Water to engage with, to divert the Course of a River, and to conduct it into another Channel, made by the Hands of Men, I make use of other very easy Works, without Piles, according to the Difficulty to be encountered in that Place.

These easy Works are nothing but Racks, in Form of Ladders, which carry the Surface of the Water of the River which is to be turn'd; which are placed on the Side perpendicularly and vertically cross the Course of the Waters, overagainst and a little below the Channel of Derivation, which has been made by Art, into which the River is to enter into a new Bed. There are made many Ranges of these Racks, which do thus cross the River in Form of a Mole; and across all the Vacuities of the Bars, the Waters pass without Interruption.

The Sides of these Racks being fast bound with Cords, at their Crossings at the cross Quarters of the Timber, and at the Discharges which secure them on all Sides, the Channel of Derivation being hollowed, and ready to receive the Waters of the River, many Fascines are

thrown between two of these Racks, good Store of which have been provided beforehand, at the Foot of the Work; or of Flints or Stones, for to make them sink to the Bottom of the Racks; which will cause the River to swell, and constrain it, by little and little, to enter into the little Channel prepared for it.

And one may have the Satisfaction to see, according as the ordinary Course of the River is obstructed, and the Waters being abridg'd of their usual Current, will increase in the new Channel of Derivation; so that this last being commonly but one Tenth, or one Twentieth of that of the River that has been stopp'd, it may be perceiv'd visibly to grow larger, and the Water to carry along with it all that it meets in its Way; as Rocks which they could not remove out of the Way; Stumps and Roots of Trees, that the Workmen were not able to get out of the Way; so that by that Time the Waters have pass'd that Way for twenty-four Hours, it becomes spacious, and proper to receive all the Waters of the River, were they twice as many as they really are.

This Method, says M. Gantier, I made use of twenty-five Years since, upon the River de Neste, in the Plain of *Aventignan*, which empties itself into the *Garonne*, at the Foot of the *Upper Pyrenees*, at *Montrejaux*; where the Masts could not float, but against the Rocks; which render'd every Day the Ragers in Danger of perishing, and where a great many had before perish'd, running no Risk in crossing

crossing the Plain; with Works as easy, and even slighter, than I had turned the Course of the *Aude*, in the *Lower Pyrenees*, within the same Bounds, and in as many Places as its Course changed, especially where these simple Works were constructed.

Lastly, I also made use of the same Expedient in turning the River *Orb* above *Besiers*, for the Use of a Mill; where I had five Foot of Water to turn off.

The Sides of these Racks are nothing but Trees cleft with Wedges, and bored in the Manner of Ladders.

Elm, or Poplar, &c. are Trees proper for this Work. The Holes are made with a large Boring-Iron, or with small Chisels, about the Space of ten or twelve Inches the one from the other.

And the Bars of these Racks are only Pieces of Wood, and the Ends of Branches of all Sorts of the like Trees, made into Stakes, from two, to three Inches Diameter, more or less; for you must have of all Sorts.

Lastly, The Waters of a River may be lower'd one or two Feet, in respect to its Fall, by hollowing the Bed.

For this Purpose, so much of the Sand is cleared away at the Sides of the River as is judg'd necessary, in order to enlarge it by lowering the Waters; for this is certain, the more it is enlarged, the more are the Waters lower'd.

Also a Number of Stakes may be stuck in those Places, where the Current of the Water is not very rapid, to clear the Bottom

of Ballast; against which Planks may be nailed, which may force the Water to pass under them with the greater Weight, and consequently with the greater Rapidity; and by that Means, remove and hollow the Heap of Sand, which it would be very laborious to take away any other Way.

And also loaded Boats may be used for the same Use; which fasten'd with Cords, and placed on the Places that are to be cleared of the Ballast, by letting them lie there some Time, the Water which these Boats press over them, by stopping the Course of the River, causes it to pass with a Rapidity according as they are more heavily loaded, so that at Length the Waters hollow a Bed for themselves.

All these Methods are made use of, more or less easy, according as Occasion requires, which the Prudence of him who directs the Work makes use of, as he finds most for his Purpose, that he may have the least Trouble to pile the Foundations of a *Bridge*, having the less Height of Water to lower.

When a Person has laid down the Projection of a *Bridge*, either of Carpentry, or Masonry, over any considerable River, and there is a Difficulty in bringing to the Place the Materials for the Work, the Ways necessary for bringing them are to be prepar'd.

For a *Bridge* of Carpentry, a large Boat is used; upon which, Scaffolding is erected, or an Engine is placed, and [a Sonnetti] Instrument proper for ramming down

down the Piles ; to which Boat are brought in other lesser Boats, the Piles, Flood-Gates, Stones, Planks, and other Materials.

1. Of what Thickness or Substance the Butments of all Sorts of *Stone-Bridges* ought to be, or what Proportion they ought to bear to the Arches, and the Weights they are to support.

2. What Proportion the Piers or Pilasters ought to bear to the Apertures or Heights of the Arches, and the Weights they are laden by.

3. What ought to be the Length of the Vouffoirs, from their *Intradosse* to their *Extradosse*, or from their inner Face to their outer Face, for Arches of all Sizes, quite up to their Key-Stone.

4. What Sort of Arches fixed upon one and the same Diameter, would be capable of sustaining the greatest Burthens, and the several and exact Degrees of Strength, whether they be of an Elliptical, Circular, or Third Point ; or *Gothick*, and carried up to what Height you please.

These Principles, which are here to be laid down, must be well known and indubitable.

Which Principles must be explain'd by evident Terms, and in a known Language, that they may be intelligible to every body, and lie open to their Judgment.

Now it will require no extraordinary Genius to comprehend what I have to offer towards the clearing up of the four Difficulties here propos'd ; and I am not without Hope, that the meanest Workman, who has but

common Sense on his Side, will unravel and demonstrate what I have here to advance.

First, By the Assistance of common Sense, and by the Help of some small Smattering in Physics, and some Skill in Argument together, you may readily comprehend the Combination or Conjunction of the several Materials employed in the building of Arches and Vaults : For they will give to understand, that were it not for the several Methods of squaring or cutting of Stone, or for the Mortar which binds them together, it would be altogether impossible to construct an Arch of any Sort.

The Antients only practis'd the first Method above, in their finest Works, without making use of any Mortar ; as may be seen in the Archivolts of their Arches, whose Vouffoirs have no Mortar at all between their Joints.

An Example of this is still visible in the antique Aqueduct *Dugard*, in *Languedoc*, and elsewhere ; and also in the Amphitheatre at *Nismes* ; where the Joints of the Stone are perfectly free from Mortar ; as also in the Vaulting of the Temple of *Diana* at the same Place.

But these Examples are not always to be regarded or followed, and especially where the Smallness of the Materials (such as Bricks) do absolutely require to be firmly bound with Mortar, to strengthen the Work, and to enable it to stand.

Secondly, It will be necessary, that you should be well enough

acquainted with Staticks, to know that whatever turns upon an Axis, after the Manner of the Scales of a Balance, whose Brachia are either equal or unequal, will never be in *equilibrium* with another Body, if that Body be not of equal Weight with the Body at first propos'd; or if by a reciprocal Distance from the Centre or Axis, it be not brought to have a Pressure downwards, to counter-balance the Pressure of its opposite Weight.

By the Knowledge of this, we provide against the Push or Impulsion of Arches, by keeping them within due Bounds, by the Assistance of Forces of a Power equal to their Push or Effort to spread or part asunder.

Thirdly, You are to have Recourse to Mechanicks, to judge of the Strength of all these Bodies, and the Power of moving Forces; and in what Respect, and after what Manner, these Bodies, which are supported or born up in the Air, act upon those that are fixed upon Earth, and which are looked upon as immovable; such as the Arch of a *Bridge*, or a Vault, which have very various Powers upon the Butments and Piers which support them, and which are supposed to be immovable.

And upon this Account, a Knowledge of Stone-Cutting is necessary; by which you may determine the several Powers of the *Voussoirs*, one upon another: For there is no *Voussoir*, which being differently inclin'd, (though it may be cut by the very same

Moulds,) but what acts in a Manner peculiar to itself, upon those upon which it is placed, or upon which are placed over it; so that they all act differently, according to the different Inclinations of their Planes.

Fourthly, Geometry will be necessary for the right Understanding of these four Propositions, that you may be able to determine or calculate the Surfaces and solid Content of these Bodies in Question, thereby to come at their Powers, and to compare them with one another.

A small Portion of these above specified Sciences, acting in Concert with common Sense, will be sufficient for the clear conceiving of what I shall here advance.

I shall omit nothing that can contribute to render what I have to say plain and intelligible to Persons of the meanest Capacity, for whom alone I have undertaken this Task.

The Learned M. *De la Hire* pretends to have demonstrated the Push of Vaults, and determin'd the Thickness of *Piedroits* which support them.

The Vaults in his Work are Arches of *Bridges*; and the *Piedroits* are the Culees or Abutments.

It is, says he, a Problem, that is one of the most difficult in Architecture, to know the Force of *Piedroits* of Vaults for sustaining their Push; and Architects have not yet found out any certain Rule for determining it.

This Problem appertains to Me-

Mechanicks ; and by the Help of that Science, we may be able to solve it, by making some Suppositions, which are agreed upon as to the Construction of these Sorts of Works.

The Push of Vaults, is the Effort that all the Stones which are form'd, cut into Quoins, and called Vouffoirs, make to remove or disperse the Jaumbages or Piedroits which sustain these Vaults.

And as those Persons who have been less bold in their Enterprizes, have allow'd an extraordinary Force to these Piedroits, to render their Works the more durable, as has been the Practice of most of the Antients ; and others, on the contrary, have been too daring in making their Piedroits too weak, and so delicate, as not to seem to be able to support the incumbent Weight ; I have thought it necessary, by the Help of Geometry, to search after a Rule by which we may arrive at a Certainty, in determining the Force or Power that they ought to have.

It has been generally observ'd, that when the Piedroits of a Vault are too weak to sustain the Push of it, the Vault cracks or splits about the Middle, between its Impost and the Middle of the Key-Stone ; and therefore it may be supposed, that in the upper Half of the Demi-Arch, the Vouffoirs are so firmly united the one with the other, that they form, as it were, but one entire Stone : And upon this Supposition, and the Solidity of the Foundation on which these Piedroits are placed, the Demonstration of the following Rule is

establish'd. See Page 70. of the *Memoirs of the Academy in the Year 1712.*

M. *De la Hire* enters upon the Business, gives the Figure of a Vault of which he undertakes to shew the Push, and determine the Largeness the Piedroit ought to have that is to support it.

Upon which, our Author M. *Gautier* remarks as follows :

I own ingenuously, says he, that I have not Genius enough to comprehend it. I have never been able to follow his Operation, as he has compos'd it ; and I look upon all that he has told us, as what those who are but half-learn'd, and especially Workmen, are not able to comprehend : For if Algebra, from which he borrows his Assistancess, be absolutely necessary to be known, in order to conceive what he says, I believe, scarce any Stone-Cutter, Mason, or Architect, for whom Treatises of this kind ought to be rendred as easy as possible, will be any Thing profited by it ; because such Persons in common, don't apply themselves to that Science, as unnecessary to their Profession, and their Time being wholly taken up in the working Part.

If M. *De la Hire* had well solved these Difficulties, in such a Manner as had rendred them intelligible and easy to those who are employed in Building, as he was able to have done, being better qualify'd for it than any Man, he would have done a Work very much desired, and would have prevented me.

We find in the *Memoirs of the Royal Academy of Sciences, in the Year 1704.* upon the Figure of
of
j

of the Extradosse or outward Face of a circular Vault, whose Voussoirs are *in equilibrio* among themselves, that a Vault, or a Semicircular Arch, being placed upon the two Piedroits, all the Stones or Voussoirs which compose this Arch, being made and placed, one with the other, so that their Joints being prolonged, all meet together at the Centre of the Arch.

It is evident that all these Voussoirs have the Form of a Coin larger above than below; by Vertue of which they rest, and are sustain'd by one another, and reciprocally resist the Effort of their Weight, which would incline them to fall.

The Voussoir in the Middle of the Arch, perpendicular to the Horizon, and which is called the Key, or Key-Stone of the Vault is sustain'd on both Sides by the Voussoirs next to it, exactly as by inclin'd Planes; and consequently the Effort it makes towards falling, is not equal to its Weight, but is a certain Part of it, by so much greater, than the inclin'd Planes which sustain it are the less inclin'd.

So that if they were but never so little inclin'd, that is to say, perpendicular to the Horizon, as well as the Key of the Vault, it would tend to falling by its own Weight, and would not be any more sustain'd, but would actually fall, if the Cement, which is not here consider'd, did not hinder it.

The second is sustain'd by the third, which is on the Right or Left of the Key of the Vault, is sustained by a third Voussoir;

which, by Reason of the Form of the Vault, is necessarily more inclin'd, in respect to the second, than the second is in respect to the first; and consequently the second Voussoir, in the Effort it makes towards falling, exerts a lesser Part of its Weight than the first.

For the same Reason all the Voussoirs, beginning from the Key of the Vault, proceed always exerting a less Part of their whole Weight: And, in fine, this last, which is placed upon a Horizontal Surface of a Piedroit, does not exert any Part of its Weight; or, which is the same Thing, makes no Effort towards falling, because it is entirely sustained by the Piedroit.

If you will have it, that all these Voussoirs make an equal Effort towards falling, where they be *in equilibrio*, it is visible, that every one, from the Key of the Vault to the Piedroit, do continually exert a lesser Part of their whole Weight. The first, for Example, exerting but one Half, the second one Third, the third one Fourth, &c. there is no other Way of making these different Parts equal, but by augmenting in Proportion the Wholes of which they are Parts; that is to say, that the second Voussoir be heavier than the first, and the third than the second, and so on to the last; which ought to be of an infinite Weight, that it may make no Effort towards falling; and that one Part being void of Weight, may not be equal to the finite Efforts of the other Voussoirs, at least, that this Weight be not infinitely great.

To

To have a clearer Idea of this Matter, there needs only a Reflecting upon this, that all the Vouffoirs, except the last, can't let any other Vouffoir fall without its being raised; and that they resist this Elevation to a certain Point determin'd by the Greatness of their Weights, and by the Part of it which they exert; that there is none but the last Vouffoir, that can suffer another to fall, without being in some sort elevated or raised itself; and that only gliding Horizontally, that the Weights, as far as they are bounded, bring not a Resistance to the Horizontal Movement; and that they do not begin to have there any finite one, but as when they are conceived as infinite.

M. *De la Hire*, in his *Treatise of Mechanicks*, printed in 1695, has demonstrated, that this was the Proportion upon which the Weight of the Vouffoirs of a Semicircular Arch are to be augmented, to the End that they may be all in *equilibrio*.

Which is the surest Disposition that can be given to a Vault, to make it durable.

Till this Time, Architects had no certain Rule, and wrought in the Dark, or by Guess.

If we number the Degrees of a Quadrant, or quarter of a Circle, from the Middle of the Key of a Vault, to a Piedroit, the Extremity of each Vouffoir will appertain to, or be Part of an Arch, by so much greater as it is farther distant from the Key.

According to M. *De la Hire's* Rule, the Weight of one Vouffoir must be augmented above

that of the Key, as much as the Tangent of the Arch of this Vouffoir exceeds the Tangent of the Arch from the Half of the Key; the Tangent of the last Vouffoir necessarily becomes infinite, and so consequently does its Weight.

But as Infinity has no Place in Practice, so the Matter comes to this, To load the last Vouffoirs as much as possible, to the End that they may be able to resist the Effort the Vault makes towards Splitting; which is what is called the Push.

M. *Parent* has made an Enquiry what should be the outward Bending, or the Extradosse of a Vault, whose Intradosse, or interior Face, is a Semicircle; and all the Vouffoirs in *equilibrio* by their Weight, according to M. *De la Hire's* Rule.

For it is manifest, that all these Vouffoirs, unequal in a certain Proportion, would bear or push outwards a certain regular Curvature. He has not found it but by Points, but in a very plain Manner.

So that by his Method a Vault may easily be constructed, of which one may be sure, that all the Vouffoirs will be in *equilibrio*.

One considerable Advantage may be gain'd by the Inquisition of M. *Parent*, is, that he has at the same Time discovered the Measure of the Push of a Vault, or what Relation this Push has to the Weight of the Vault.

He only knew, that this Effort was very great, and therefore opposed to it great Masses

of

of Stones or Abutments, rather too strong, than too weak; but we knew not precisely what Proportion to keep to: But this, we may come to a Knowledge of at present, that Arts always are improving by the Help of Geometry, &c.

See, by what Rules, all those who have been Builders, have conducted themselves, or have been guided by others until this Time, in making Piedroits for the Support of Vaults, as well as the Abutments of Bridges.

The Learned Father *Deran*, in his Treatise *De la Coup des Pierres*, and M. *Blondel*, Architect to the King of France, as skilful Men as any the preceding Age has afforded, in his Treatise of Architecture proceeded on the same Foot as those who succeeded them.

In any kind of Vault or Arch of a Bridge whatsoever, say they, either Elliptick, Semicircular, or of the third Point, and a Portion of a Circle divided in the Circumference in the Intradosse, or interior Face, into three equal Parts, *Plate I. Fig. I.* as may be seen in the semicircular Figure at A O, O P, and L M, prolonged in on, P M In S, so that M S may be equal to P M. Let fall a Diameter S R prolonged from the Point S upon A R, which will determine the Thickness of the Abutment by M R, prolong this Perpendicular to Q, until it meets or touches E Q, being continu'd; and this will give the Thickness of the Masonry below, or to the Bottom of the Intradosse.

This Operation is not proved to make it evident, that it is just and true: So there is nothing to be said of it; and so what follows must be put to the Venture.

That which is the most remarkable in this Construction of all these different Arches, is; says M. *Blondel*, the Differences of their Pushes, that is, the Force which they have each in particular to charge the Piers or Piedroits which bear them, more or less: For it is certain, the higher an Arch is carry'd, the less does it push. When on the contrary; Flat or Straight Arches, are such whose Push is the strongest; which is either augmented or diminish'd, according to the Difference of their Straightness, more or less.

Therefore it is to the Purpose, to give the different Thicknesses of Piers or Piedroits, according to the Difference of their Pushes, conformable to the Operation which I shall produce anon.

See what he has follow'd upon this Difficulty in the Execution of his Bridge of *Xaintés*.

He makes his Piers as three to eight, in Proportion to the Opening of the Arches, and to the Pier at the End of the *Pont-Levis*, which serves for an Abutment, and which is cut off, he has allowed one Sixth of Breadth more; because it should sustain on this Side the Push of all the ches which are at the Centre; by which it will be easy to judge whether he has follow'd the Method which he has prescrib'd to us, and which he makes a general Rule.

Arches;

Palladio tells us, that the Heads of *Bridges*, by which Name, he calls the Abutments, ought to be very solid, and advises to make them at those Places where the Brinks of Rivers are rocky or soft Gravel, on good Ground; or that else they must be made firm by Art, by other Piers, or by other Arches.

He afterwards speaking of Arches, says, that those that are semicircular, are the strongest; because they bear entirely upon the Piers, without pushing one another.

When one is constrain'd by a too great Height, one may make them diminish'd Straight Arches, so that the perpendicular Height upon the Line of their Chord may be the Third of the same Chord; in which Case, the Abutments must be extremely well fortify'd.

In the Description that he has given of the *Bridge of Rimini*, built by *Augustus*, he gives seven Feet and a half to the Abutments, which support Arches of an Opening of twenty Feet. He afterwards gives the Proportions of that built upon *Bachiglione*, an antique *Bridge*, where the Abutments are three Foot and a half wide, supporting Arches of an Opening of twenty Feet.

The Abutments of the antient *Bridge of Rerone*, have no more Breadth than three Foot and a half, and support Arches of an Opening of twenty-five Feet, as he tells us.

And this all the Account that Architects have given us concerning the Abutments of *Bridges*: From which, certainly, we cannot take any Measures for ma-

VOL. I.

king a general Rule, and coming to any Certainty, nor to be able to give any Reason for what we do.

But I shall, says *M. Gautier*, undertake one without any Preamble.

If we examine the first Figure, we shall see that *AM* is the Diameter of a Semicircular Arch *AEM*; or it may be flat, *Gotbick*, or any other that you please, whose Push you are desirous to know, in order to proportion a Butment to it, or a Power equal to it.

Continue the Diameter *MA* indefinitely, and upon a Level towards *C*.

Raise the Perpendicular *AD* indefinitely, upon the Foot of the Arch *A*, whose Point *A* must be look'd upon as immoveable.

Then from the Point of Support, or the Foot of the Arch *A*, to the Middle of the Bottom of the Key, produce the Line *AE*, and from the aforesaid Point of Support *A*, with the Opening *AE*, describe the Quadrant *DEB*, which will intersect the Line *AM* in the Point *B*, and *AD* indefinitely in *D*. Now it is certain, that *AB*, *AE*, and *AD*, are equal in this Case, as they are all Radii of one and the same Circle. Produce *AC* also equal to *AB*.

Then produce the Hypotenuse *BD*, which shall intersect *AE* in the Point *I*.

From the Point *I*, let fall the Perpendicular *IL* upon *AD*, which will be the half of *AB*.

From the Summit or Top of *E*, produce indefinitely the Line *EG* parallel to *BC*, which will intersect

K

intersect

intersect AD in H , and set off the Line IL from H to G , which will serve for a Butment to the Arch AEM , by letting fall the Perpendicular GU .

DEMONSTRATION.

1. If you examine the Disposition of this Figure, you will find that CB being upon a Level, and AB being considered as the Half of the Platband or Face of a Beam, &c. it could not remain in that Posture, if it was not counterbalanced by AG which is equal to it, and opposite with it on the other Side of the Point of Suspension, support A , which is immoveable.

Now AC is equal to AB , whether in Length, in Power, or in Weight, &c. then AC must equiponderate, or be *in æquilibrio* with AB . Let us here suppose AB to have a Force of ninety Degrees; thereby the better to illustrate our Demonstration, and make it familiar to every Body.

2. But this Half of the Platband or Beam AB is raised perpendicularly upon itself in the Point of Support A , as may be observ'd in AD .

So that neither leaning to one Side nor the other, it can have no Power nor Pressure towards B or C , as it had before, so that there is no Need of any Thing to keep it *in æquilibrio*; for the Point of Support A is sufficient for that, inasmuch as we here suppose it to be immoveable: And thus the Platband or Beam perpendicularly placed in AD will have no Force; which we will express by a Cypher, instead of having a Force which

we have here called ninety Degrees, when its Direction was Horizontal, as AB .

3. In short, this same Platband or Beam AB , whose Force is ninety Degrees, being placed in AE , with an Inclination of forty-five Degrees, between AD and AB 90. It is certain, that its Power will be mix'd, or to speak plainer, it will be a mean Proportion between AB and AD ; so that if the first has a Push of ninety Degrees, and the Force of the other is nothing, AE will observe a Medium between them, and consequently will have a Force of forty-five: And thus the Half of AB , which is AN , will be sufficient to counterbalance it, which is the same with IL , or HG , which will be able to counter-balance AE , which was to be prov'd: So that AB , the Half of the Platband or Beam, whose Force is ninety Degrees, being to AD 90, as IL , the Half of AB , whose Force is forty-five, is to LD 90, and in a reciprocal Proportion to each other, the Push AE of the Arch AEM will be HG , as that of the Platband AB will be AC , which was to be demonstrated.

Thus you are to proceed in investigating the Pushes of Schem- Arches, which are less than a Semicircle, as well as those of *Gothick* Arches, which are more, by comparing an Arch of any Sort with the Demonstration here laid down in relation to a Semicircular Arch, whose Push is always determin'd by the Line BD ; and in this is equal to IL .

From what I have said above, it will be evident, that MR ,
which

which is the Butment, according to the Method of Father *Deran*, and M. *Blondel*, is widely different from A V, which I have just now demonstrated to be the proper Butment.

That if the Arch AEM was converted into a Platband, or Straight Arch AM, the Half of it would be counterbalanced by A T, which is equal to it.

I apprehend, that the meereft Smatterers in Geometry, such as the greateft Part of Master-Masons and Stone-Cutters are, will understand what I have been saying, and be able to trace it out, and demonstrate it to their own Satisfaction.

Of the Straight Arch, Fig. II.

Let GA and HC be the Sides of the Walls of the Butments, or rather of the Piedroits, which are to sustain a Straight Arch.

Let AC be the Space between the Walls; which also will be the Length of the Straight Arch; and which we will suppose to be ten Feet, or ten Fathoms, or any Measure else you please.

Draw the Line CA, and with the Opening of the Compasses AG, constitute the equilateral Triangle AFC, and from the Point F with the same Opening of the Compasses FA, describe the Segment of a Circle AEG, which shall be bisected equally in E, upon the aforesaid Segment AEC, the Height BE, which is about one Eighth of AC, will give the Height of the Straight Arch, for squaring or cutting of the Stones which are to compose it.

Then continue CA to D, so

that AE may be equal to BE, the Half AC: Now it must be evident, that the Push, Pressure, or Impulsion of AB being equal to the Resistance or Force of DA, the Straight Arch cannot shove or push the Wall GD beyond the Axis CA; and thus AD will be the Thickness of the Butment and Piedroit, or the Walls which are to sustain the Impulsion or Push of the Platband or Straight Arch; which, indeed, is more frequently used in Civil Structures, to support Platforms, Ceilings, or Roofs of Galleries, or other Passages a-crofs a Court; and in Churches, to serve for Tribunes, than for Bridges. There is a very fine one in the Church of the Jesuits at *Nismes*, which was constructed by the Direction of the Father *Mourgues*, and after the Design of the late Sieur *Cubijol*, who was a very skillful Architect, to which he gave less Height at BE than what we allow here; whether it was, that he was assured of the Soundness or Solidity of the Stones, or the Truth of the Work, &c. As his Design is perfectly bold, I shall here give some Account of it.

The Platband or Straight Arch we are here speaking of, is four Fathoms, two Feet, and six Inches in Length; the Stones of it are one Foot in Thickness; their Height BE is two Foot towards the Key, and at each End AG CH.

They begin with two Foot four Inches. This Platband or Straight Arch had a Rise about six or seven Inches at B, when its Stones were set together

upon the Centre ; but it afterwards sunk down three Inches, when its Joints came to settle, upon the taking away of the Centering or Stay ; so that at this Day, it rises about four Inches above B.

The Practice of this Sort of Work, and a Knowledge of the Soundness or Hardness of the Stone, are what must guide you in regulating the Height BE ; but for want of sufficient Experiments, we are still in the Dark as to this Matter ; there not having yet been found out any Rule in Mechanicks to determine it.

The skilful Architect must do in this according to the best of his Knowledge: If he succeeds, he will be esteem'd and applauded ; but if he fails, he is despised and laughed at.

However, by repeated Experiments, and Proofs of the Consistence of Stones, it would not be impossible to ascertain some sure Rules, with regard to this Matter.

For it is of the greatest Importance to know the different Solidity and Firmness of Stones, and other Bodies, which vary considerably, according to their several Climates, and Grains, that we may be able to proportion their Substance to the Efforts, Pressures, or Pushes of Straight Arches, or others, which being once calculated (*viz.*) the Weights of the Efforts of the Bodies, which the Haunses of the Platbands of the Voussiors of Arches are to sustain.

We may imagine the Strength of Stones we are to use by ta-

king a Piece of them of a Cubical Inch in Dimension, that is, in Form of a Dye, and by loading it with Weights, till it disperses, and yields to the Pressure of its super-incumbent Burthen ; from whence some certain Rules may be established with regard to this Matter. Thus,

If such a Cube of Stone, as we have mention'd, supports a Weight a Thousand or a Million of Times heavier than its own Weight, and bigger than itself, we will allow it but one quarter of that Resistance or Force, when we come to apply it to the Building of our Works, whether they be Piers, or *Bridges*, which are to sustain the greatest Burthens ; or whether they be Voussiors of Vaults, or Archivolts of *Bridges* ; which are the Parts that give or exert the greatest Efforts or Push, as well as Stones of Straight Arches, whether they are to support Towers, or Steeples, &c.

Thus I allow three Fourths of the Strength of those Bodies, to make Amends for the Imperfections of the Work ; for there is no Man whatever that can set or join them together in any Building, with that exact Arrangement in which they were placed by Nature in the Beds or Strata of the Quarries from whence they were raised.

Clumsy Joints, stuff'd up with Mortar, and Shells, which do not bear throughout equally, and consequently yield to the Pressure of the superincumbent Weight, is the Reason why Buildings every Day split and settle from the Difference of the Binding.

Binding, which is not equally firm in all its Parts; from whence arise very disagreeable Deformities, and Eye-sores, as well as very prejudicial Accidents to the Work itself.

The Joints between B and C of the Platband or Straight Arch, are indented, (*Plate II.* which are sometimes ordered after a very different Manner; for there are those who like a plain uniform Joint best, such as you see between B and A; but this depends upon the Skill, or at least the Fancy of the Architect: For the more complex Joints are (say some,) the more they are confus'd, and the more subject to Defects; but the more simple and plain they are, the truer and stronger is the Work; as those Joints between A and B, which are plain.

What I have here offered by Way of discovering the several Degrees of the Strength and Solidity of Materials, is something like the Experiment made by the *Gentlemen of the Royal Academy of Sciences*, upon a twisted Cord, composed of twenty Yarns or Threads; each of these Yarns, when single, were capable of sustaining one Pound Weight without breaking; but being twisted together, and converted into a Cord, they could not bear up a Weight of twenty Pounds; for it broke with a Weight of between sixteen and eighteen Pounds. For it is impossible for human Art to twist these twenty Yarns so nicely together, as that all of them shall sustain an equal

Share of the Burthen suspended by them, when in a Cord; so that some of them loaded with a Weight superior to their Strength, they are all in general unequally or disproportionally laden; from whence it must appear, that they must be unable to bear the Weight of the twenty Pounds before mention'd.

Thus supposing a Cubical Inch of Stone to be able to bear a hundred Pound, it would not from thence follow, that ten such Cubes would sustain a Burthen of a thousand Pounds; because a Mass or Body of that Weight would not bear alike upon all the Ten; wherefore some of them being more heavily laden than others, they would all be crush'd one after another; from whence happens the flying or breaking of the Stones of an Archivolt, and of all Bodies; which are not upon an Equality throughout the whole Plane of their Superficies, or Beds.

The following Table gives the Proportions of the Length of the Vouffoirs, or the Heights of the Archivolts, as they can be gathered and ascertain'd from the best Authors Works of Antiquity; which cannot be reduced to an exact Geometrical Demonstration, and has been merely calculated from the Experience of the more solid or coarse Consistence of Stones; upon which Point, this whole Article turns.

So that Physicks bear a greater Share of this, than either Mechanicks or Geometry.

What ought to be the Largeness of Piers in respect to the Openings of the Arches, and the Weights they sustain.

The Size of Piers ought to be precisely determin'd according to the Spring of the Arches.

No Person yet has laid down any certain Rule as to this. I shall relate what the most accomplish'd Architects have told us in relation to this Matter.

Leon Baptiste Albert would have the Piers of a *Bridge* be equal in Number and Size, and their Largeness, one third Part of the Opening of the Arch.

Palladio says, the Piers ought to be equal in Number, to the End that there may be one Arch in the Middle, where there is commonly the greatest Current of the Water.

That the Piers ought not to be less than a sixth Part, nor commonly more than a fourth Part of the Width of the Arch.

He next gives some Examples of ancient *Bridges*, and says, that those of the ancient *Bridge* of *Rimini* are eleven Feet, and the Opening of the Arches twenty-five Feet: That the *Bridge* of *Bachiglione*, which is also ancient, the Piers are five Feet, and the Arches thirty in their Opening: That the *Bridge* over the *Rerone* has its Piers also five Feet, which support an Arch whose Opening is twenty-nine.

He, after this, gives the Projection of a *Bridge*; where he makes the Piers two Fathoms wide, to support an Arch whose Opening is ten Fathoms.

Serlio says, that the Piers at

Pont Sixtus at *Rome*, have one Third of the Width of the great Arches; that the Piers of the *Bridge* of *St. Angelo*, formerly *Adrian's-Bridge*, are one Half of the Breadth of the grand Arch, which is a femicircular one.

That at the *Bridge* of *Quattro-Capi*, *Tarpeius*, or antiently *Fabricius*, the Piles are also one Half of the Breadth of the femicircular Arches: And, in fine, that the *Bridge* *Milvius*, at present called *Ponte Mole*, the Piers are there half the Breadth of the Arches.

M. Blondel makes the Piers of his *Bridge* of *Xaintes* as three to eight, in respect to the Opening of the Arches.

The Piers of the antient *Bridge* *Du Gard* are two Fathoms wide, and support three Arcades, two of which are at Bottom sixteen Fathom of the Opening of a Height of near twenty-five Fathom; which is an immense Weight upon so small a Space as two Fathoms. We are assured that the Towers of *Notre-Dame*, at *Paris*, are but thirty Fathoms high. If so, they are not raised higher than the *Pont de Gard*, but about seven Fathoms.

The Piers of *Pont Neuf*, at *Paris*, are but fifteen Foot wide, or thereabouts, at the Master-Arch.

Those of *Pont Royal*, on the *Thuilleries*, are but two Fathoms, one Foot, six Inches, or thereabouts, and support an Arch of twelve Fathoms, opening at the middle one.

Those of *Pont Neuf*, in *Toulouse*, are four Fathoms wide, or thereabouts, and support Arches of

of Opening from fifteen to sixteen Fathoms, or thereabouts.

Too great a Variety in all these Works, gives us Ground to think, that Authors have not yet observed any certain or general Rule, founded upon demonstrable Principles for establishing the Piers of *Bridges*.

But nevertheless, one may draw from all these Models something that may be serviceable to us on Occasion; it is not to be doubted, but that these able Architects, who have conducted all these Works, had a Reason for all the Projections of these Piers, before they erected them.

I do not all doubt, but that a Pier of two Fathoms wide, wholly built of large Blocks of hewn Stone, as is that of the Antique *Pont Degard*, which bears more, perhaps, than any other in the World besides, will not be sufficient to support the Effort of an Arch of an Opening of twenty Fathoms; when another Pier of four Fathoms will not support an Arch of ten, which shall be constructed only of hewn Stone, and the Inside of the Body of the Work of simple rough Walling, or Shards or Pieces of unhewn Stone.

This would break sooner than the first: this would heap up all the Weight of its Charge or Load, and the last would be immovable.

It is upon these Principles, and the using Materials more or less solid, and differently arranged, which we should have Regard to, and determine as to the Width of Piers in all Sorts of *Bridges*.

The same Materials used in different Countries, some of

which have a firmer Consistence than others used for building Gates of Cities, Fortifications, Towers, Steeples, *Bridges*, &c. might be examin'd, in order to gain from thence the Advantage one desires for projecting a *Bridge*, greater or smaller, in these Places.

And although by all these Examples I have form'd a Rule for determining the Piers of all Sorts of *Bridges*, according to the foregoing Tables, which is one Fifth in an Arch of ten Fathoms Opening; a larger or lesser Breadth may be allow'd to Piers, in regard to the greater or lesser Solidity of the Materials that are made use of.

With this Remark, that if the Bed of a River is very wide, then a greater Breadth may be allow'd; because there is no need of fearing of penning up the Waters, in Case of Inundations, but on the contrary, in the Beds of Rivers that are too close pent up and straighten'd, it will be of great Importance, not to give the Piers of *Bridges* which one builds, but as little Width as can be, that we may be able to support without Fear the Load of the Arches; especially when at the same Time we are ty'd up by the unfavourable Disposition of the Places.

In constructing the following Table, I have observed the Proportion of one Fifth of the Width of the Piers, in respect to the Openings of the Arches, from those of twenty Feet Opening, and upwards; and those which are under ten, a small Arch of three Feet Opening, and even to that of one Foot.

It is found by this Table, that a Pier ought to be one Foot ten Inches wide for an Opening of three Feet ; and one Foot six Inches for an Opening of one Foot ; which may be practis'd upon any Common-Sewer, or on any Stream of Water, how small soever, whose Piers are made all of hewn Stone, when by Reason of the bad Situation of the Place, we shall be oblig'd to it ; and the Whole is proportion'd not only to the Mass of Masonry, which the Piers ought to support, but also to the Stream of Water that is to pass under it.

As we cannot come at the Knowledge of the Solidity of the Materials, but by making Trials, in order to know how far their Effort will be able to sustain the Weight that they are to be charged with, Experiments may be made, as in the preceding Chapter, upon which this Table is fram'd ; since there is no Rule, which exactly determines the Breadth of the Piers more after one Manner than another.

The Table which I have given of the Breadth of the Piers of all Sorts of Arches, from that of twenty Fathoms Opening, is proportion'd as well as possibly I could do it, from all that has been done ; on which I have thought proper to make Observations as to this Matter.

What Bearing Voussoirs should have from their Intradosse or interior Curvity or Face of the Arch, to their Extradosse or exterior Curvity in Arches of all Largenesses, to the Place of the Key-Stone.

See what the most able Archi-

teets have said, who have written on this Matter.

M. *Blondel* says, that they have not so solid Stone at *Paris*, for the building of *Bridges*, as the *Romans* have in *Italy*.

And that to supply this Defect, they have made at *Pont Neuf*, and the *Thuilleries*, Voussoirs of a great Length, and at the same Time very well secured by the Returns and Courses of the Croissettes, to make an infinitely greater Binding, and to take a much better Hold.

The *Bridge of Toulouse* may, without Difficulty, be put upon a Foot parallel with the finest in *Europe*.

Nevertheless it is built with nothing else but Bricks, except that at the Angles or Heads of the Arches, there are some Rows in the Intradosse, or interior Face of the Arch, where hewn Stones are us'd ; which are certainly no more than the principal Parts of its Ornaments ; and it may be said, that although the Arches which are about sixteen, and so many Fathoms the Opening, are, for all that, made only of Brick, situated in the Cut, according to the Bearing which Voussoirs and Pendants should have.

After that Manner, that this Disposition, so well establish'd together with good Mortar, which they used, and that makes the Binding, forms a Work which seems to be all of one Piece, although compos'd of very small Materials.

And this is the Reason that the Arrangement join'd to the Solidity of these Materials, is the Cause of the Whole of its Goodness.

Leon-

Leon-Baptista Alberti says, that the Height of the Headband or Fillet of Arches in considerable *Bridges*, which is what the *French* call Vouffoirs, or their Bearing from the Intradosse to their Extradosse, when they are thus determin'd on their Extradosse Arches, ought never to be less than one Fifteenth of the Width of the Opening of the Arches which they form.

It is upon this, I have establish'd the Column of Vouffoirs in the following Table, supposing the Mafonry to consist entirely of large Blocks of very hard hewn Stone.

And it is upon the same Principles, that the ancient *Bridge Dugard* was made.

But nevertheless I have not omitted to determine the same Vouffoirs, when there are none but soft or tender Stones to be used.

Palladio says, that the Vouffoirs of the Arches of *Bridges* should be made of very long and well jointed Stones, but does not determine their Length. When he speaks of the *Bridge of Rimini*, whose Arches are semicircular, the Vouffoirs, where the Headband has one Tenth of the Opening of the Arches, which are twenty Feet in Diameter.

In that of *Bachiglione*, whose Arches are Scheam ones, that in the Middle of the Opening of thirty Feet, the Height of its Headband is one Twelfth of the Diameter; and the Space above the Key-Stone of the great Arch, which is between the Headband and the Cornice, is equal to half the Headband.

In the ancient *Bridge of Rerone*, as the two before mentioned upon an Arch of an Opening of twenty-nine Feet, the Headband has the same Proportion as the preceding.

In a particular Design which *Palladio* gives of a very fine *Bridge* which he has projected, the grand Arch of which has ten Fathoms for the Diameter [flatted] makes not the Headband, or the Length of the Vouffoirs, but one Seventeenth of the Width of the grand Arch, and one Fourteenth of the smaller, which have an Opening of eight Fathoms.

See what *Serlio* says as to the *Palatine Bridge at Rome*, antiently called *Senatorius*, he remarks, that the Headband of the Arch at its greatest Height, is one Twelfth of the Breadth of the Arch.

As to the *Bridge of Quattro Capi*, antiently called *Fabricius*, of which there are but two antique Arches remaining, the Headband of the Arches which are of the Rustick Form, and whose Vouffoirs are the one longer than the other alternately, that which has the most Bearing, is one Tenth of the Breadth of the Arch.

The *Bridge Milvius* has its Headband in Projecture, in Form of a Plinth quite plain, and whose Height is one Tenth of the Diameter of the Arch.

This is the Substance of all that the most accomplished Architects have left us as to the Proportions of Vouffoirs.

B R

B R

A TABLE of the Proportion of all the principal Parts of Semicircular *Bridges*, from an Arch of one Foot opening to an Arch of twenty Fathoms, or one hundred and twenty Feet; the Differences of their Culees, or Abutments, Piers, and Vouffoirs.

The Open- ings of Ar- ches.	Culees or A- butments.			Piers.			Vouffoirs of hard Stones.			Vouffoirs of soft Stones.		
Feet.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.
1	2	6	6	1	6	0	1	0	6	1	6	0
2	2	9	0	1	8	0	1	1	0	1	7	2
3	2	11	6	1	10	0	1	1	6	1	8	4
4	3	2	0	2	0	0	1	2	0	1	9	6
5	3	4	6	2	2	0	1	2	6	1	10	8
6	3	7	0	2	4	0	1	3	0	2	0	0
7	3	9	6	2	6	0	1	3	6	2	0	8
8	4	0	0	2	8	0	1	4	0	2	1	6
9	4	2	6	2	10	0	1	4	6	2	2	3
10	4	5	0	3	0	0	1	5	0	2	3	0
11	4	6	9	3	1	3	1	5	6	2	4	0
12	4	8	6	3	2	6	1	6	0	2	4	6
13	4	9	9	3	3	9	1	6	6	2	5	0
14	5	0	0	3	5	0	1	7	0	2	6	0
15	5	1	9	3	6	3	1	7	6	2	6	9
16	5	3	6	3	7	6	1	8	0	2	7	0
17	5	5	3	3	8	9	1	8	6	2	8	0
18	5	6	0	3	9	0	1	9	0	2	9	0
19	5	7	9	3	10	3	1	9	6	2	9	3
20	5	10	0	4	0	0	1	10	0	2	9	6
21	6	0	11	4	2	5	1	10	6	2	9	9
22	6	4	0	4	5	0	1	11	0	2	10	0
23	6	6	6	4	7	0	1	11	6	2	10	3
24	6	9	7	4	9	7	2	0	0	2	10	6
25	7	0	6	5	0	0	2	0	6	2	10	9
26	7	3	5	5	2	5	2	1	0	2	11	0
27	7	6	6	5	5	0	2	1	6	2	11	3
28	7	9	0	5	7	0	2	2	0	2	11	6
29	7	11	7	5	4	7	2	2	6	2	11	9
30	8	3	0	6	0	0	2	3	0	3	0	0

B R

B R

The Open- ings of Ar- ches.	Culees or A- butments.			Piers.			Vouffoirs of hard Stones.			Vouffoirs of soft Stones.		
	Feet.	Ft.	Inc. Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.
31	8	5	11	6	2	5	2	3	6	3	0	10
32	8	9	0	6	5	0	2	4	0	3	1	8
33	8	11	0	6	7	0	2	4	6	3	2	6
34	9	2	7	6	9	7	2	5	0	3	3	0
35	9	5	6	7	0	0	2	5	6	3	3	10
36	9	6	6	7	2	6	2	6	0	3	4	0
37	9	9	6	7	5	0	2	6	6	3	4	6
38	10	0	0	7	7	0	2	7	0	3	5	0
39	20	3	1	7	9	7	2	7	6	3	5	6
40	10	8	0	8	0	0	2	8	0	3	8	0
41	10	11	3	8	2	5	2	8	10	3	8	10
42	11	2	8	8	5	0	2	9	8	3	9	8
43	11	5	6	8	7	0	2	10	6	3	10	6
44	11	8	11	8	9	7	2	11	4	3	11	4
45	12	0	0	9	0	0	3	0	0	4	0	0
46	12	3	3	9	2	5	3	0	10	4	0	10
47	12	6	8	9	5	0	3	1	8	4	1	8
48	12	10	0	9	7	0	3	2	6	4	2	6
49	13	0	11	9	9	7	3	3	4	4	3	0
50	13	4	0	10	0	0	3	4	0	4	3	10
51	13	7	3	10	2	5	3	4	10	4	4	8
52	13	10	8	10	5	0	3	5	8	4	5	6
53	14	1	6	10	7	0	3	6	6	4	6	4
54	14	4	11	10	9	7	3	7	4	4	7	2
55	14	8	0	11	0	0	3	8	0	4	8	0
56	14	11	3	11	2	5	3	8	10	4	8	10
57	15	2	8	11	5	0	3	9	8	4	9	7
58	15	5	6	11	7	0	3	10	6	4	10	3
59	15	8	11	11	9	7	3	11	4	4	11	2
60	16	0	0	12	0	0	4	0	0	5	0	0
61	16	3	3	12	2	5	4	0	10	5	0	10
62	16	6	8	12	5	0	4	1	8	5	1	8
63	16	9	6	12	7	0	4	2	6	5	2	6
64	17	0	11	12	9	7	4	3	4	5	3	0
65	17	4	0	13	0	0	4	4	0	5	3	10
66	17	7	3	13	2	5	4	4	10	5	4	8
67	17	10	8	13	5	0	4	5	8	5	5	6
68	18	1	6	13	7	0	4	6	6	5	6	4
69	18	3	11	13	9	7	4	5	4	5	7	2
70	18	6	0	14	0	0	4	6	0	5	8	0
71	18	11	3	14	2	5	4	8	10	5	8	10
72	19	3	8	14	5	0	4	9	8	5	9	7
73	19	5	6	14	7	0	4	10	6	5	10	3
74	19	8	11	14	9	7	4	11	4	5	11	2
75	20	0	0	15	0	0	5	0	0	6	0	0
76	20	3	3	15	2	5	5	0	10	6	0	10

B R

B R

The Open- ings of Ar- ches.	Culees or A- butments.			Piers.			Vouffoirs of hard Stones.			Vouffoirs of soft Stones.		
Feet.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.	Ft.	Inc.	Lin.
77	20	6	8	15	5	0	5	1	8	6	1	8
78	20	9	6	15	7	0	5	2	6	6	2	6
79	21	0	11	15	9	7	5	3	4	6	3	0
80	21	4	0	16	0	0	5	4	0	6	3	10
81	21	7	6	16	2	5	5	4	10	6	4	8
82	21	10	8	16	5	0	5	5	8	6	5	6
83	22	1	6	16	7	0	5	6	6	6	6	4
84	22	4	11	16	9	7	5	7	4	6	7	2
85	22	8	0	17	0	0	5	8	0	6	8	0
86	22	11	3	17	2	5	5	8	10	6	8	10
87	23	2	8	17	5	0	5	9	8	6	9	7
88	23	5	0	17	7	0	5	10	6	6	10	3
89	23	8	11	17	9	7	5	11	4	6	11	2
90	24	0	0	18	0	0	6	0	0	7	0	0
91	24	3	3	18	2	5	6	0	10	7	0	10
92	24	6	8	18	5	0	6	1	8	7	1	8
93	24	9	6	18	7	0	6	2	6	7	2	6
94	25	0	11	18	9	7	6	3	4	7	3	0
95	25	4	0	19	0	0	6	4	0	7	3	10
96	25	7	3	19	2	5	6	4	10	7	4	8
97	25	10	8	19	5	0	6	5	8	7	5	6
98	26	1	6	19	7	0	6	6	7	7	6	4
99	26	4	11	19	9	7	6	7	4	7	7	2
100	26	8	0	20	0	0	6	8	0	7	8	0
101	26	11	3	20	2	5	6	8	10	7	8	10
102	27	2	8	20	5	0	6	9	8	7	9	7
103	27	5	6	20	7	0	6	10	6	7	10	3
104	27	8	11	20	9	7	6	11	4	7	11	2
105	28	0	0	21	0	0	7	0	0	8	0	0
106	28	3	3	21	2	5	7	0	10	8	0	10
107	28	6	8	21	5	0	7	1	8	8	1	8
108	28	9	6	21	7	0	7	2	6	8	2	6
109	26	0	11	21	9	7	7	3	4	8	3	0
110	29	4	0	22	0	0	7	4	0	8	3	10
111	29	7	3	22	2	5	7	4	10	8	4	8
112	29	10	8	22	5	0	7	5	8	8	5	6
113	30	1	6	22	7	0	7	6	6	8	6	4
114	30	4	11	22	9	7	7	7	4	8	7	2
115	30	8	0	23	0	0	7	8	0	8	8	0
116	30	11	8	23	2	5	7	8	10	8	8	10
117	31	2	8	23	5	0	7	9	8	8	9	7
118	31	5	6	23	7	0	7	10	6	8	10	3
119	31	8	11	23	9	7	7	11	4	8	11	2
120	32	0	0	24	0	0	8	0	0	9	0	0

N.B. *That which I have frequently rendered here, Headband or Fillet, M. Gautier expresses by Bandeau, which is the common English, according to A. Boyer: But M. Gautier makes it the same as Intradosse; which he explains to be the interior Curvity of a Vault, Arch, or Vouffoirs of a Bridge.*

Experiment.

In order to be fully confirm'd in what I have here advanced concerning the Push or Pressure of Arches, Vaults, the Length of Vouffoirs, or the Height of Archivolts, says M. *Gautier*, I had Recourse to the following Experiments.

I got a small Semi-Arch of ten certain Measures in Diameter, and semicircular, as in the last Table.

This Semi-Arch I compos'd of nine Vouffoirs (See *Fig. II. AB CD, Plate I.*) which were made of Wood, and turn'd it up against a Wall in ABE, as against an immoveable Key upon the Half-Centre BCE.

Having thus placed the nine Vouffoirs CB upon the Half-Centre CB, I loaded them behind with other Pieces of Wood, equal to them in Bulk, and alike in Weight: I then placed nine more one upon another, after the same Manner, as you may see in the Figures FG, and behind them, I ranged the four others at HI.

This done, I uncentred the Semi-Arch EBC, and it remain-

ed unmoveable in the Position you see it in the *Figure I.*

I afterwards took away the Pieces of Wood which form the Butment, and keep in the Reins or Sides of the Arch one after another, beginning at the Top, according to the Numbers 9, 8, 7, 6, 5, 1, 13, 4, 12, 3; so that there remained but the four undermost, viz. 11, 2, 10, 11; which four supported the Semi-Arch without falling, ABCD; But as soon as I began to remove the 11th, the Vouffoirs fell asunder.

This Experiment gave me to understand, in the first Place, that the Mass of Stone-Work, which the Sides or Declivity of Vaults are laden by, serve them for a Support to keep the Vouffoirs in *equilibrio*, that they may not deviate or depart from the Curve form'd by their Centre, and likewise that their strongest Push is in that Place.

2. Though this Experiment was made with Pieces of Wood (which consequently were very light,) that had nothing between their Joints to keep them together, they nevertheless keep each other up by means of their Mould or Cut; the Pattern of which I had given to a Joiner to make them by.

Thirdly, This Experiment confirms me in the Opinion, that if we made our Archivolts without any Mortar, Cement, or Cramps, in Imitation of the Antients, and afterwards ran a kind of fine Mortar, or Cement made of pulveriz'd Stones into the several Abreuvoirs, the Work would be much more durable than it can

be with thick beds of Mortar, which yield to the immense Weight of the superincumbent Stones.

Fourthly, From this Foot of the Semi-Arch I raised the Perpendicular CK, and found that the Vouffoirs BC, which are intersected by the Line CK, never attempted to fall asunder till the Part of the Butment CH was made lighter than the Semi-Arch CB, which confirms what I said before.

Thus the Vouffoirs, together with the Materials they are laden with, ought to be *in equilibrio* with the Butment, which you would have to resist their Push, or the Work must infallibly fall to pieces.

I have calculated the above Table, in order to make these Things familiar to Persons who are ignorant of Geometry.

Which of the several Sorts of Arches, fixed or erected upon one and the same Diameter, would be capable of sustaining the greatest Weight; and in Proportion their Efforts or Pushes are to one another, whether they be Scheam, Elliptical, Semicircular; or, in short, of the third Point.

If due Attention be given to what I have already laid down, it may be allow'd, that the Pushes of all Arches of different Degrees of Flatness, are to the Weight by which they are laden, as their several Degrees of Inclinations are to the Breadth of the Butment which is to secure them; and it will also be found that those, whose Push is the least inclin'd, (or oblique,) will be able to sustain greater Burthens

than those which border upon the straight Arch, which is the weakest of all.

Let us suppose the straight Arch (A, Fig. I. Plate II.) to be a Beam transported or remov'd to AC, Fig. IX. Now it is certain, that if in this Situation it was laden with a Weight of 100 *lb.* and it should happen to break it, it would nevertheless be able to bear not only a Weight of 100 *lb.* but also a Weight infinitely greater, if it was raised perpendicularly, as AB.

But I shall put the Case here, that it would bear 200; and therefore 150 being the main Proportional between 100 and 200, or between the first Push (as we will call it) and the second, it will be found that the Beam, being elevated to 45 Degrees in AD, it will bear that Weight, (*viz.*) 150 *lb.* form'd as a semicircular Arch.

If you lower it down to AF, to form the Elliptical Arch, it will be found, that if you take the main Proportional between the semicircular Arch AD and the Beam (or straight Arch) AC, which is AF, the Ellipsis AF will bear but 125.

In short, the main Proportional between the semicircular Arch, which is 150, and the Power or Force of AB, which 200, will be 175, and that will be expressly the Strength of the Gothic Arch AE.

Thus the higher an Arch is carried up, the stronger will it be; and the flatter or lower it is, the weaker.

This Argument may be determined to the nicest Exactness, when

when you shall have discovered or agreed upon the Difference of the Strength of a Beam, when laid down like a straight Arch, as A C, and when erected perpendicularly A B.

From this Demonstration I infer, that the *Gothic* Arch is stronger than the semicircular, the semicircular Arch stronger than the elliptical, and this last than the straight Arch.

This Figure IX. in Plate II. helped me to make an Experiment, whereby to find the Weight of all sorts of Bodies at different Inclinations, as may be learned from the following Paragraph.

Of the Weight of Bodies at different Inclinations, and the Manner of calculating it.

A Body A B, (Plate II. Fig. II.) uniform throughout its whole Length, Breadth, and Thickness, no matter whether round or square, weigh'd 100 upon the Point of Support A, and erected perpendicularly, as A B.

But when this same Body A B was laid down horizontally, or on a level upon the Points A and C E, which were equidistant from the Centre or Middle, and Extremities of it, it pressed upon the first Point of Support A with a Weight of 50 only; because as the whole Weight is equally supported by the Points A and C, the whole Weight aforesaid is equally divided between them: Thus, as it bears 50 upon A, and 50 upon C, the Sum of those two Numbers is 100 the whole Weight.

When I alter'd the Position of this Body A C, by giving it an Elevation of 45 Degrees in A D, I found that weighing in the whole 100 Parts that pressed upon D with a Weight of 25 only; wherefore it must press upon A with a Weight of 75, in as much as the Sum of those two Numbers gives 100, the whole Weight which was to be.

I then made two other Experiments, by elevating the aforesaid Body from A D to 67 $\frac{1}{2}$ in E, by depressing or declining to 22 Degrees $\frac{1}{2}$ in F; upon the Point E it pressed with a Weight of 12 $\frac{1}{2}$ only, the Point F with a Weight of 37 $\frac{1}{2}$; and consequently I found that E A, at an Elevation of 67° 30', pressing after the Rate of 12 $\frac{1}{2}$ only upon the Point E, must press with a Weight of 87 $\frac{1}{2}$ upon its Point A; and also that A F, at an Elevation of 22° 30' must press upon its Point A with a Weight of 62 $\frac{1}{2}$. And thus you will find it in continued Proportion by subdividing the Parts B E, E D, D F, and F C.

From hence I calculated a Table; which shews that the Body A B presses the greater upon its Point of Support A, the higher it is elevated above the Level A C in F, or towards D, &c. and inversely, that the aforesaid Point of Support A is the least pressed the more the Body A B quits its Perpendicularity, and is inclined towards E D F and C, and so on, beneath the Level A C, by a reverse Position, indeed, but, however, in the very same Proportion.

In order to this, I have suppos'd the Body AB to be uniform throughout its whole Dimensions, and to weigh 100 equal Parts, (no matter whether Pounds, or any other Weight,) and to be one hundred equal Parts in Length.

Having laid down this for a Foundation, I found no Difficulty in investigating the Effort and Power of all Bodies whatsoever, more or less inclin'd, whether in Lines or Curves; for by reducing the Curves to straight Lines, or at least by supposing the Curves to be equally supported by the Extremities of their Chords; and by comparing the Chords with one another, I resolve the Strength and Weight of all Arches and Vaults, of whatsoever Figure they be, whether regular or irregular.

But you must previously consult the following Table, where it will be seen, at the first Column, the various Degrees of the Inclination of Bodies, whose Weight we would calculate.

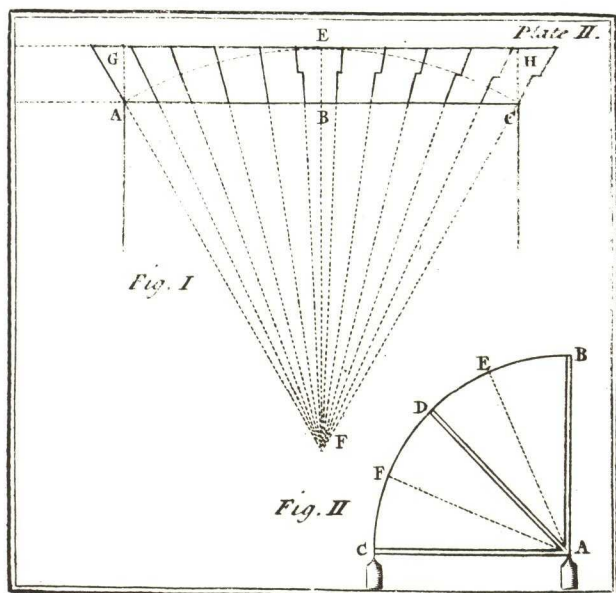
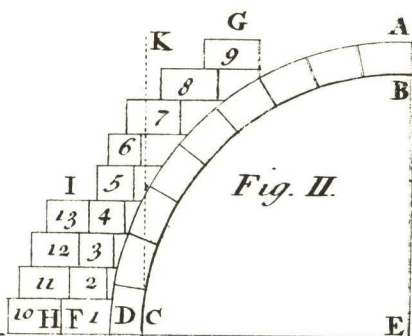
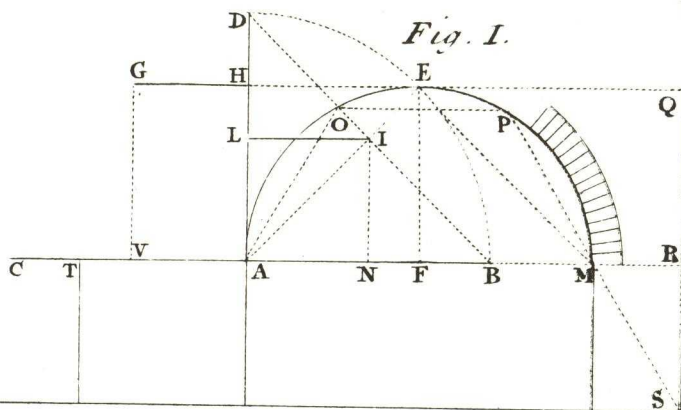
You must again suppose the Body to weigh an hundred Pounds, or any Thing else, or any other Number, which answers to the equal Parts into which it is divided, and the Inclination of the Body shall be determined by a certain Number of Degrees.

This being premised, let there

be an Arch of any other inclin'd Body, to whose Weight or Pressure at the Key you would know.

Let us suppose it to be the Half of the semicircular Arch, (Fig. I. Plate I.) whose Pressure or Weight you would know at the Key E; calculate the Stone or Brick Work EHA of the Semi-Arch, which you may easily do by a previous Knowledge of the Weight of a cubic Foot of either of those materials, and you may come to the Knowledge of the rest. For suppose that EHA weighs 9750 lb. the Half of which will be 4875 lb. but the Chord of the Semi-Arch is at an Inclination of 45° , therefore (from the Table below,) say, If 50, the last Number or Term, gives the Weight of 25, at an Inclination of 45 Degrees, how much will 4875, the Half of the Weight of the whole Triangle AHE, give? And it will come out $2437 \frac{1}{2}$; so that the Body EHA, weighing in all 9750, will weigh at the Key at an Inclination of 45° $2437 \frac{1}{2}$; which last Number being subtracted from 9750, it will be found to weigh or push at the Foot or Couffinet $7312 \frac{1}{2}$.

It is after this Manner that you are to determine, with regard to the Strength of Buttresses, for the Support or Vaults, Walls, &c.





B R

B R

A TABLE of the Proportions of the Weights
and Pushes of Regular Bodies, at all De-
grees of Inclinations.

The Number of Quantities of an inclin'd Body to
be determined.

Deg.	lb.	Oz.	Deg.	lb.	Oz.	Deg.	lb.	Oz.	Deg.	lb.	Oz.
1	0	8	24	13	7	47	26	1	70	38	8
2	1	9	25	13	8	48	26	2	71	39	9
3	1	10	26	14	9	49	27	3	72	40	0
4	2	11	27	15	0	50	27	4	73	40	1
5	2	12	28	15	1	51	28	5	74	41	2
6	3	13	29	16	2	52	28	6	75	41	3
7	3	14	30	16	3	53	29	7	76	42	4
8	4	15	31	17	4	54	30	8	77	42	5
9	5	16	32	17	5	55	30	9	78	43	6
10	5	17	33	18	6	56	31	0	79	43	7
11	6	18	34	18	7	57	31	1	80	44	8
12	6	19	35	19	8	58	32	2	81	45	9
13	7	20	36	20	9	59	32	3	82	45	0
14	7	21	37	20	0	60	33	4	83	46	1
15	8	22	38	21	1	61	33	5	84	46	2
16	8	23	39	21	2	62	34	6	85	47	3
17	9	24	40	22	3	63	35	7	86	47	4
18	10	25	41	22	4	64	35	8	87	48	5
19	10	26	42	23	5	65	36	9	88	48	6
20	11	27	43	23	6	66	36	0	89	49	7
21	11	28	44	24	7	67	37	1	90	50	8
22	12	29	45	25	8	68	37	2			9
23	12	30	46	25	9	69	38	3			0

Draw-Bridge, is one that may be drawn or taken up by Means of a Sweep, or Counterpoise, and which shuts up against a Gate. There are others with Pitfalls and Beams, sustained by two large Stakes fifteen Foot high; one Part of which lowers as the other rises.

TO BRING UP, a Term used among Workmen, especially among Carpenters, when they are talking with Bricklayers: Thus they say, *Bring up* the Foundation so high; *Bring up* such a Wall; *Bring up* the Chimneys, &c. which is as much as to say, Build the Foundation so high, Build the Wall; Build the Chimneys, &c.

BROAD STONE, is the same with Freestone; only this is so called, because raised broad and thin out of the Quarries, viz. not more than two or three Inches thick.

As to its Use: The Use of this Sort of Freestones, which are called *Broad-Stones*, is for paving Court-Yards and Passages, and before Shop-Doors, as in Walks or Paths in the City of London, to separate them from the Highway.

As to their Price: If the Breadths and Lengths are promiscuous, then the common Price for fitting and laying the Stone in Mortar, from 6*d.* to 8*d.* per Foot square, or from 4*s.* to 6*s.* per superficial Yard.

But some of these Stones are cut into perfect Squares, like Paving-Tiles, but much larger, as eighteen, twenty, or twenty-four Inches square or more; but as these are neater, so they are dearer; some Pavements of these

being worth 18*d.* per Foot; and if the Stones are good, and well polish'd, as they ought to be for Kitchens, Dairy-Houses, Brew-Houses, &c. they will be worth 15, or 16*d.* per Foot.

SPANISH BROWN is a dark dull Red, of a Horse-Flesh Colour. It is an Earth that is dug out of the Ground: But there is some of it pleasant enough to the Eye, considering the Deeness of it.

It is of great Use among Painters; being generally used as the first and priming Colour, which they lay on upon any kind of Timber-Work, being cheap and plentiful, and a Colour that works well, if it be ground fine; which may be done with less Labour, than some better Colours do require. That which is of the deepest Colour, and the freest from Stones, is the best.

The other Sorts are not so good to give a Colour to the Eye, but yet they serve as well as any other for the Priming Colours, to season the Wood to lay other Colours upon.

BUFFET, a little Apartment, separated from the rest of the Room, by slender Wooden Columns for placing China, Glass-Ware, &c. Called also a Cabinet.

The *Buffet*, among the *Italians*, called *Credenza*, is inclos'd within a Balustrade, Elbow-high.

BUILDING, is used to signify both the Constructing and Raising of an Edifice; in which Sense, it comprehends as well the Expences, as the Invention and Execution of the Design.

In *Building* there are three Things to be considered; *viz.* First, Commodity or Convenience. Secondly, Firmness. Thirdly, Delight.

To accomplish which Ends, Sir *Henry Wotton* considers the whole Subject under two Heads, *viz.* the Seat or Situation, and the Work.

1. As for the Seat: Either that of the Whole is to be considered, or that of its Parts.

2. As to the Situation, Regard is to be had to the Quality, Temperature, and Salubrity or Healthfulness of the Air; that it be a good healthy Air, not subject to foggy Noisomeness from adjacent Fens or Marshes; also free from noxious Mineral Exhalations: Nor should the Place want the sweet Influence of the Sun-Beams; nor be wholly destitute of the Breezes of Wind, which will fan and purge the Air; the Want of which would render it like a stagnated Pool, or standing Lake of Air, and would be very unhealthy.

Pliny advises not to build a Country-House too near a Fen or Standing-Water; nor yet over-against the Stream and Course of a River; because the Fogs and Mists which arise from a large River, early in a Morning, before Day-Light, cannot chuse but be very unwholesome.

Dr. *Fuller* advises chiefly to chuse a wholesome Air: because, says he, the Air is a Dish one feeds on every Minute; and therefore it had need be salubrious.

Cato advises, that a Country-House have a good Air, and not to lie open to Tempests, seated

in a good Soil, and let it exceed therein, if you can; and let it stand under a Hill, and behold the South, in a healthy Place.

As to Commodiousness, or Convenience, Sir *Henry Wotton* advises, that the House or Seat have the Convenience of Water, Fuel, Carriage, &c. that the Way to it be not too steep, and of an incommodious Access, which will be troublesome both to the Family, and Visitants. And as for the Convenience of being supply'd with Necessaries, it should not be seated too far from some Navigable River, or Arm of the Sea.

Wood and Water, says Dr. *Fuller*, are two Staple Commodities.

As for Water; the Want of it is a very great Inconvenience, the Detriment of many Houses to which Servants must bring the Well upon their Shoulders.

And as to Wood; where a Place is bald of Wood, no Art can make it a Perriwig in Haste.

Optical Precepts, or Maxims Such I mean, says Sir *Henry Wotton*, as concern the Properties of a well-chosen Prospect; which may be stiled the Royalty of Sight. For as there is a Lordship (as it were) of the Feet whereon a Man walk'd with much Pleasure about the Limits of his own Possessions, so there is a Lordship likewise of the Eye which being a ranging and imperious (I had almost said) usurping Sense, cannot endure to be circumscrib'd within a small Space, but must be satisfy'd both with Extent and Variety: Yet on the other Side, I find vast and indefinite Prospects, which drown

all Apprehensions of very remote Objects condemn'd by good Authors, as if some Part of the Pleasure (whereof we are speaking) did thereby perish.

Agreeableness and Pleasantness of Prospect is to be valu'd.

Dr. *Fuller* says, a Medley View (such as of Land and Water, at *Greenwich*) best entertain the Sight, refreshing the weary Beholder with Change of Objects: Yet, says he, I know a more profitable Prospect, where the owner can only see his own Land round about him. And to this Head of Situation, he adds, as follows:

A fair Entrance with an easy Ascent, gives a great Grace to a Building, where the Hall is a Preference out of the Court, the Parlour out of the Hall; not (as in some old Buildings,) where the Doors are so low, that Pigmyes may stoop; and the Rooms so high, that Giants may stand a-tiptoe.

A political Precept: That great Architect Sir *Henry Wotton* says, One private Caution, which I know not well how to rank among the rest of the Precepts, unless I call it political, is this, *viz.* By no Means to build too near a Great Neighbour; which were to be as unfortunately seated on the Earth, as *Mercury* is in the Heavens; for the most part ever in Combustion or Obscurity, under brighter Beams than his own.

Contrivance.: The Situation being fix'd on, the next Thing in Order, is Contrivance; which being a Thing of great Moment in this Affair of *Building*; before it is entered upon, it will be ne-

cessary to give some few general Precautions.

First, let no Person, who intends to build a Structure that shall be either useful or ornamental, begin it without the Advice or Assistance of a Surveyor, or Master-Workman, who understands the Theory of *Building*, and is capable of drawing a Draught or Model according to the Rules of Art.

In a Draught (which may serve indifferently well in small Buildings) there ought to be the Ichnography of each Floor, and also the Orthography of each Face of the *Building*, *viz.* the Front, the Flanks, and the Rear.

But if the Artizan be well vers'd in Prospective, then more than one Face may be represented in one Diagram stenographically.

In contriving these Designs, whether by Draught or Model, the Quality of the Person, for whom the Edifice is to be erected is to be considered, in regard to the Ichnographical Plots especially.

For Noblemen have Occasion for more Rooms of Office, than other Persons of a meaner Degree. All which ought to be design'd according to their most convenient Occasions; with their Lengths and Breadths according to Proportion. Likewise the Ichnography of all Chimneys, both as to the Length and Breadth of the Hearths, Jaumbs, Bed-Places, and Stairs; and the Width of all Doors, and Windows, in each Contignation or Floor.

And if it be required, in Timber Buildings, the Length, Breadth,

Breadth, and Thickneſs of Ground-Plates or Cells, Breſt-Summers, (and in all, whether Timber, Brick, or Stone *Buildings*;) the Dimenſions of Summers, Girders, Trimmers, or Joists.

Alſo in the upper Floor, the Scantling of Dragon-Beams, Raiſons, or Raiſing-Pieces, or Wall-Plats, &c.

And alſo the Thickneſs of Partitions, Walls, &c. in Brick or Stone Fabricks.

All which, and all other Parts (whether in the Ichnography, or Orthography) of *Buildings*, ought to be repreſented; as alſo Ovens, Stoves, Broilers, Furnaces, Coolers, Fats for Brewing, &c. with their juſt Meaſures to the beſt Advantage, as to Conveniency, Health, Strength, and Ornament.

All which Dimenſions ought to be ſet in the proper Places to which they belong in the Diagrams in Characters; becauſe if the Schemes be not very large, it will be very difficult to take the Dimenſions of the ſmaller Parts nicely, if not of the great ones themſelves; for it will ſcarce be practicable, to take either of them to an Inch, nor perhaps, to two, three, or four Inches, according as the Diagram may be in Amplitude.

In the Orthographical Schemes, there muſt be true Delineations and Dimenſions of each Face, and all its Concomitants, as Doors, Windows, Balconies, Turrets, or Cupola's, Chimney-Shafts, Faſcias, Ruſtick Quoins, Architraves, Friezes, Cornices, Pediments, Pilasters, Columns,

Shells over Doors, Lanthorns, and all other Ornaments.

If it be a Timber *Building*, all the Members in that Face ought to have their ſeveral Sizes in Characters, and true Poſitions by the Scale.

As for Example: The Ground-Plates or Cells, Introduces, Breſt-Summers, Beams, Principal Poſts or Braces, Quarters, Prick-Poſts, or Window-Poſts, Jaumbs, or Door-Poſts, or Puncheons, King-Pieces, or Joggle-Pieces, Struts, Collar-Beams, Door-Heads, Principal Rafters, Shreadings, &c.

The Ichnography, Orthography, and Stenography of the Stair-Caſe may alſo be delineated, and all its Parts, as Hand-Rails, Riſers, Noſeing of the Cover or Top, String-Board and Mouldings on it, as Car-touzes, Balluſters, Pendants, &c. with their true Poſitions, Forms, and Dimenſions; all which, if they be carefully done by an ingenious Surveyor, a Workman will hardly be like to commit any Blunder.

Sir *Henry Wotton* adviſes as to this Matter, as follows:

First, Let no Man who intends to build, ſettle his Fancy on a Draught on Paper or Vellum of the Work or Deſign, how exactly ſoever delineated or ſet off in Perſpective, without a Model or Type of the whole Structure, and of every Parcel and Partition, either of Paſte-board, or Wainſcot.

Secondly, Let the Model be as plain as may be, without Colours, or other Beautifying, leaſt the

Pleasure of the Eyes preoccupe the Judgment.

Thirdly, and Lastly, The bigger this Type is, so much the better it is: Not that I would perswade any Man to such an Enormity as that Model made by *Antonio Labaco*, of *St. Peter's Church* in *Rome*, containing twenty-two Feet in Length, sixteen in Breadth, and thirteen in Height, which cost four thousand one hundred and eighty-four Crowns, the Price of a reasonable Chapel; yet in a Fabrick of forty or fifty thousand Pounds, there may very well be thirty Pounds expended in procuring an exact Model; for a little Penny in the Premises, may easily create some Absurdity or Error of a far greater Charge in the Prosecution, or at the Conclusion of the Work.

What *Sir Henry Wotton* here advises, is very requisite, especially for large and sumptuous Buildings, either publick, or private; but it is not worth the while to be at the Charge of a Model for every little Dwelling-House which Men build for their own Conveniency.

I shall here add as to the Conveniency, what is recommended by *Sir Henry Wotton*, that the Chief Rooms, Studies, Libraries, &c. should lietowards the East; that those Offices which require Heat, as Kitchens, Brew-Houses, Bake-Houses, and Distillatories, to the South; those which require a cool fresh Air, as Cellars, Pantries, Granaries, to the North; as also Galleries for Paintings, Musæums, &c. which require a steady Light.

He tells us, the antient *Greeks* and *Romans* generally situated the Fronts of their Houses towards the South; but the modern *Italians* vary much from this Rule.

And, indeed, as to this Matter, Regard must still be had to the Country, each being forced to provide against its Inconveniencies: So that a good Parlour in *Egypt*, might make a good Cellar in *England*.

The Situation being fixed on, and the Design and Contrivance design'd, the next Thing to be consider'd, is the Work itself; under which the principal Parts are first to be consider'd; next, the Accessories and Ornaments.

Under the Principals are, first, the Materials; next, the Form or Disposition.

As for the Materials, they are either Stone, as Marble, Freestone, Brick for the Walls, Mortar, &c. or of Wood, as Fir, Cyprus, Cedar for Posts and Pillars of upright Use; Oak for Summers, Beams, and Crop-Work, or for joining and Connection.

As to the Form or Disposition of a Building, it is either simple, or mix'd.

The simple Forms are either circular or angular; and the circular ones either compleat, as just Spheres; or deficient, as oval ones.

The Circular Form is very commodious, and the most capacious of any, strong and durable beyond the rest, and very beautiful; but is the most chargeable of all others; and much Room is lost by the Bending

ing of the Walls, when it comes to be divided into Apartments, besides an ill Distribution of Light, unless it be from the Centre of the Roof.

For these Reasons, it was, that the Antients used this Form only in their Temples and Amphitheatres, which had no need of Compartitions. There are the same Inconveniencies attending Oval Forms, without the same Conveniencies, being less capacious.

As for Angular Forms, Sir *Henry Wotton* observes, that *Building* neither loves many nor few Angles. The Triangle is condemn'd above all others, as wanting both Capaciousness and Firmness; as also not being capable to be resolved into any other regular Figure in the inward Partitions besides its own.

As for Forms of *Building* of five, six, seven, or more Angles, they are much fitter for Fortifications, than Civil *Buildings*.

There is indeed, a celebrated *Building* of *Vignola* at *Caparole*, in the Figure of a Pentagon; but the Architect had very great Difficulties to grapple with as to the Disposition of the Lights, and the saving the Vacuities.

So that such *Buildings* seem rather for Curiosity than Conveniency. And for this Reason, Rectangles are generally chosen, as being a Medium between the two Extremes.

But then Authors are in Dispute, whether the Rectangle should be an exact Square, or an Oblong. Sir *Henry Wotton* prefers the Oblong, provided the Length exceeds not the Breadth by more than one Third.

As to Mixed Forms or Figures, a Judgment may be made of them from what has been already said of simple ones; only that they have this particular Defect, that they offend against Uniformity.

Indeed, Uniformity and Variety may seem to be Opposites: But Sir *Henry Wotton* observes, that they may be reconciled; by Instances in the Structure of the Human Body, where they both meet together.

Some observe, that in building Houses long, the Use of some Rooms will be lost; and they will take up more for Entries and Passages, and will require more Doors: And if a *Building* be a Geometrical Square, if the House be any Thing large, the middle Rooms will want Light more, than if they were built in the Form of an H, or some other such like Figure, unless there be a Court in the Middle of it: Which was the Method of building great Houses in former Times.

Some much commend this Way of building an House in the Form of a *Roman* H: For they say, this Form makes it stand better, and firmer against the Winds; and that the Light and Air comes to it every Way, and every Room is nearer one to the other.

Some approve of this Form very much; because in it, the Offices may be remote from the Parlour and Rooms of Entertainment, and yet in the same House, which may serve very well for a Country Gentleman's House.

In *Buildings* of this Form, some propose the Disposition of the Apartments thus :

In the Front of one of the long Part of the H, is to be the Kitchen, the Bake-House, Brew-House, and Dairy-House.

In the same Part behind it, the Hall, in the Middle of the H, which separates the Parlours which are in the other long Part, and Rooms of Entertainment from the Offices.

Thus much for the first grand Division, *viz.* the Whole of a *Building*.

As for the Second Division, or the Parts of a *Building*, they are comprized by *Baptista Alberti*, under five Heads, *viz.* the Foundation, the Walls, the Apertures, the Compartitions, and the Covering.

1. As for the Foundation, *Vitruvius* orders the Ground to be dug up, to examine its Firmness, that an appearing Solidity is not to be trusted, unless the whole Mold cut through be found and solid : 'Tis true, he does not say to what Depth it ought to be dug. But *Palladio* determines it to a sixth Part of the Height of the *Building*.

And this is called by Sir *Henry Wotton*, the Natural Foundation, whereon the Substruction or Ground-Work is to stand to support the Walls; which he calls, the Artificial Foundation.

This then is to be level; the lowest Ledge or Row of Stone, only close laid with Mortar; and by how much the broader it is, by so much will it be the better; but at least, it should be twice the Breadth of the Wall.

Some advise, that the Mate-

rials below, be laid just as they come out of the Quarry; supposing that they have the greatest Strength in their natural Posture.

De Lorme enforces this by observing, that the breaking or yielding of a Stone in this Part, but the Breadth of the Back of a Knife, will make a Cleft of more than half a Foot in the Fabrick above.

As to Pallification, or Piling the Ground-Plat, which *Vitruvius* does so much commend, I shall say nothing here, because that is requisite only in a moist marshy Ground; which, for *Building*, should never be chosen : Nor, perhaps, are there any Instances of Pallification practised, but where they were obliged to it by Necessity.

As for Walls, they are either entire and continued, or intermitted; and the Intermissions are either Columns or Pilasters.

Entire or Continued Walls are, by some, variously distinguish'd, according to the Quality of the Materials, as they are either Stone, Brick, &c. others only consider the Position of the Materials, as when Brick or square Stones are laid in their Lengths, with Sides or Heads together; or their Points conjoined together like Net-Work. See MASONRY.

The great Laws of Walling are, *First*, That the Walls stand perpendicularly to the Ground-Work, the Right Angle being the Ground of all Stability. *Secondly*, That the massiest and heaviest Materials be the lowest, as fitter to bear than to be born. *Thirdly*, That the Work diminish in Thickness, as it rises, both

both for the Ease of Weight and Expence. *Fourthly*, That certain Courses or Lodges, of more Strength than the rest, be inter-laid like Bones, to sustain the Fabrick from total Ruin, if some of the under Parts chance to decay. *Fifthly*, and *Lastly*, That the Angles be firmly bound, they being the Nerves of the whole Fabrick: Which are usually fortify'd by the *Italians* on each Side the Corners, even in Brick *Buildings*, with squared Stones; which add both Beauty and Strength.

The Intermissions of Walls, as has been before mention'd, are either Columns, or Pilasters; of which there are five Orders, *viz.* the *Tuscan*, *Doric*, *Ionic*, *Corinthian*, and *Composite*. All which are distinctly treated under their respective Articles.

Columns and Pilasters are frequently form'd Archwise, both for Beauty and Grandeur.

As for Apertures, they are either Doors, Windows, Stair-Cases, Chimneys, or Conduits for the Suillage, &c. All which you may see considered under their proper Heads.

And as to the last, Art should imitate Nature in these ignoble Conveyances, and conceal them from the Sight, where a running Water is wanting, into the most remote, lowest, and thickest Part of the Foundation, with secret Vents: passing up through the Walls like a Tunnel to the open Air. Which is recommended by all the *Italians*, for the Discharge of noisome Vapours.

As to Compartitions or Distribution of the Ground-Plot into

Apartments, &c. Sir *Henry Wotton* lays down these Preliminaries, That the Architect do never fix his Fancy on a Paper-Draught, be it set off never so exactly in Perspective, much less on a mere Plan, without a Model or Type of the whole Structure, and every Part of it, either in Pastebord or Wood.

In the Compartition itself there are two general Views, *viz.* the Gracefulness and Usefulness of the Distribution for Rooms of Office and Entertainment, as far as the Capacity of it, and Nature of the Country will allow.

The Gracefulness will consist in a double Analogy or Correspondency. *First*, Between the Parts and the Whole; by which a large Edifice should have large Partitions, Entrances, Doors, Columns, and, in short, all its Members large, proportional to the *Building*.

The second Analogy is between the Parts themselves, not only considering their Lengths and Breadths, as we speak of Doors and Windows. But here, says Sir *Henry*, enters a third Respect of Height, a Point; I confess, saith he, scarce reducible to any general Precept.

The Antients determined their Rooms which were oblong, by double their Breadth, and their Height by half their Breadth and Length added together.

When they would have the Room a perfect Square, they made their Height half as much more as their Breadth: But the Moderns dispense with these Rules, sometimes squaring the Breadth, and making the Diagonal of it the Measure of the Height

Height, and sometimes more. This Deviation from the Rules of the Antients is ascrib'd to *M. Angelo*.

Sometimes they squar'd the Breadth, and doubled that square Number; and taking the Root of that square Number, for the Height, and sometimes more; but seldom lower for the Breadth.

But what is here mention'd is scarcely now practis'd, unless it be in a Nobleman's House; who will have a Hall, &c. higher pitch'd than the rest of the Rooms in the *Building*; and sometimes a Dining-Room; or else, for the most Part, all the Rooms of a Floor are of an equal Height: And this seems to be the most commodious Method; because in this Case, there is no Loss of Room, as there must necessarily be, where one Room is open almost to the Top of the House, as may be observed in some old *Buildings*; and then the Floor of the second Story

will lie level and even, and not in the old Method of Steps out of one Room into another.

As to the Height of Rooms, that is various amongst us, according to the Persons for whom they are built, and the Custom of the Place. In the Country, common Timber *Buildings* are usually about seven Feet one Third, or eight Foot at the most, betwixt the Floors.

The second Sort of Houses in the Country is about nine Feet between the Floors; which for the most part is the Pitch of the Rooms at *Tunbridge-Wells*.

The third Sort in the Country, (*viz.* in *Kent* and *Sussex*;) are Gentlemens Seats; which for the most part are ten or twelve Feet high, such as are new *Buildings*. But in old Stone *Buildings*, 'tis common to be much higher, *viz.* fourteen or sixteen Feet.

By Act of Parliament, for *building* of *London*, there were reckon'd four Rates of Houses, *viz.*

The $\left\{ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} \right\}$ Rate $\left\{ \begin{matrix} 2 \\ 3 \\ 4 \\ 5 \end{matrix} \right\}$ Foot at Discretion, &c.

The $\left\{ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} \right\}$ Rates, Cellars in Height, betwixt Floor and Ceiling. $\left\{ \begin{matrix} 6 \\ 6 \\ 6 \\ 6 \end{matrix} \right\}$ and a half Foot at Discretion, &c.

The $\left\{ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} \right\}$ Rate, First Story. $\left\{ \begin{matrix} 9 \\ 10 \\ 10 \\ 10 \end{matrix} \right\}$ Foot at Discretion, &c.

The

The $\left\{ \begin{smallmatrix} 1 \\ 2 \\ 3 \\ 4 \end{smallmatrix} \right\}$ Rate, Second $\left\{ \begin{smallmatrix} 9 \\ 10 \\ 10 \end{smallmatrix} \right\}$ Foot and a half,
Story, at Discretion, &c.

The $\left\{ \begin{smallmatrix} 1 \\ 2 \\ 3 \\ 4 \end{smallmatrix} \right\}$ Rate, Third $\left\{ \begin{smallmatrix} 9 \\ 9 \\ 9 \end{smallmatrix} \right\}$ Foot and a half
Story, at Discretion, &c.

The $\left\{ \begin{smallmatrix} 3 \\ 4 \end{smallmatrix} \right\}$ Rate, Fourth $\left\{ \begin{smallmatrix} 8\frac{1}{2} \end{smallmatrix} \right\}$ Foot and a half high
Story, at Discretion, &c.

The second Consideration, as to the Compartments, is the Usefulness; which consists in having a sufficient Number of Rooms of all Kinds, with their proper Communications, and without Distraction.

Here the chief Difficulty will be in the Lights and Stair-Cases.

The Antients were pretty easy as to both these, having generally two cloistered open Courts; one for the Women's Side, and the other for the Men. Thus then the Reception of Light was easy into the Body of the *Building*, which must be supply'd among us either by the open Form of the *Building*, or by graceful Refuges or Breaks, by terrassing a Story in danger of Darknefs, and by Abajours or Sky-Lights.

As for casting the Stair-Cases, it may be observed, that the *Italians* frequently distribute the Kitchen, Bake-house, Buttery, &c. under-ground, next above the Foundation; and sometimes level with the Foot of the Cellar, raising the first Ascent into the House fifteen Feet, or more; which, besides the removing of Annoyances out of Sight, and gaining so much Room above,

adds a Majesty to the whole Fabric, by elevating the Front.

Sir *H. Wotton* observes, that in *England* the natural Hospitality will not allow the Buttery to be so far out of Sight; besides, that a more luminous Kitchen, and a shorter Distance, are required between that and the Dining-Room than that Comparison will admit.

In the Distribution of Lodging-Rooms, 'tis a popular and antient Fault, especially among the *Italians*, to cast the Partitions so, that when the Doors are all open, a Man may see through the whole House; which is founded on an Ambition of shewing a Stranger all the Furniture at once; which is an intollerable Hardship upon all the Chambers, except the innermost, into which a Person cannot come, but through all the rest, unless the Walls be extreme thick for secret Passages; Nor will this suffice, unless there be three Doors to each Chamber, a Thing inexcusable, except in hot Countries.

Besides, it is a Weakening to the *Building*; and the Necessity which it occasions, of making as many

many common great Rooms as there are Stories, which devour a great deal of Room, which might be employ'd in Places of Retreat; and also must likewise be dark, as running through the Middle of the House.

In the Compartition, the Architect will have Occasion for frequent Shifts, through which his own Sagacity, more than any Rules, must conduct him.

Thus he will be frequently put to struggle with Scarcity of Ground; sometimes to damn one Room for the Benefit of the rest, as to hide a Buttery under a Stair-Cafe, &c. At other Times, to make those the most beautiful which are most in sight, and to leave the rest, like a Painter, in the Shadow, &c.

As for the Covering of a Building, this is the last in Execution, but the first in Intention: For who would build but to shelter?

In the Covering or Roof, there are two Extremes to be avoided; which are the making it too heavy, or too light. The first will press too much on the under Work; and the latter has a more secret Inconvenience; for the Covering is not only a bare Defence, but a Bond or Ligature to the whole Building.

Indeed of the two Extremes, a House top-heavy is the worst.

Care ought to be taken, that the Pressure be equal on each Side: And *Palladio* wishes that the whole Burthen may not be laid upon the outward Walls; but that the inner may likewise bear their Share.

The *Italians* are very curious in the Proportion and Graceful-

ness of the Pent or Slopeness; and divide the whole Breadth into nine Parts, whereof two serve for the Height, or highest Top or Ridge from the lowest; but in this Point, Regard must be had to the Quality of the Region: For, as *Palladio* intimates, those Climates which fear the falling of much Snow, ought to have more inclining Pentices than others.

As to the Accessories or Ornaments of a Building, they are fetch'd from Sculpture and Painting.

As for Sculpture, Care ought to be taken that there be not too much of it, especially at the first Approach of a Building; or at the Enterance, where a *Doric* Order is much preferable to a *Corinthian* one; that the Niches, if they contain Figures of white Stone, be not colour'd in their Concavity too black, but rather dusky, too sudden Departments from one to another being displeasing to the Sight.

Fine Sculptures ought also to have the Advantage of Nearness, and coarser of Distance; and likewise in placing the Figures aloft, they should be inclin'd or lean a little forward, because the visual Ray extended to the Head of the Figure is longer than that reaching to its Feet, which will necessarily make that Part to appear farther off; so that in order to reduce it to an erect Posture, it must be made to stoop a little forwards.

But *M. Le Clerc* does not allow of this Inclination, but will have every Part in its just Perpendicular.

As to Painting; the chief Things that are to be regarded are, that no Room have too much, which will surfeit, except in Galleries, &c. that the best Pieces be placed where there are the fewest Lights. Rooms with several Windows are Enemies to Painters; nor can any Pictures be seen in Perfection, unless illuminated, like Nature, with a single Light.

That in the disposing of them Regard be had to the Posture of the Painter in working, which is the most natural for the Posture of the Spectator; and that they be suited to the Intention of the Rooms they are used in.

To make a Judgment of a *Building*, Sir *Henry Wootton* lays down the following Rules.

1. That before a Person fixes upon any Judgment, he be informed of its Age; that if the apparent Decays be found to exceed the Proportion of Time, he may thence conclude, without farther Inquisition, that either the Situation is naught, or that the Materials or Workmanship are too slight.

2. If the *Building* be found to bear its Years well, then let the Viewer run back from the Ornaments and Things that strike the Eye, to the more essential Members, till he is able to form a Conclusion, that the Work is commodious, firm, and delightful; which are the three Qualities of a good *Building*, which have been laid down at first, and agreed on by all Authors.

This he accounts the most scientific Way of judging.

Vassari proposes a third, viz. by passing a running Examina-

tion over the whole *Building*, according to the Structure of a well-made Man; as whether the Wall stand upright upon a clean Footing and Foundation; whether the *Building* be of a beautiful Stature; whether it appear well burnish'd as to the Breadth; whether the principal Entrance be in the middle Line of the Front or Face, like our Mouths; whether the Windows be set in equal Number and Distance on both Sides like our Eyes; whether the Offices are usefully distributed, &c. like our Veins.

Vitruvius recommends a third Method of judging, summing up the whole Art under these six Heads.

1. *Ordination*, or the settling the Model or Scale of the Work.

2. *Disposition*, i. e. the just Expression of the first Design of the *Building*, (which two Sir *Henry Wootton* is of opinion he might have spared,) as belonging rather to the Artificer than the Censurer.

3. *Eurithmy*, i. e. the agreeable Harmony between the Length, Breadth, and Height of the several Rooms, &c.

4. *Symmetry*, or the Agreement between the Parts and the Whole.

5. *Decor*, which is the true Relation between the *Building* and the Inhabitants: From whence *Palladio* concludes, the principal Entrance ought never to be limited by any Rule; but the Dignity and Generosity of the Master.

6. *Distribution*, i. e. the useful casting of the several Rooms for Offices,

Offices, Entertainment, or Pleasure.

The last four of these are always to be run over, before a Man passes any determinate Censure: And Sir *Henry Wotton* says, are sufficient to acquit or condemn any *Building* whatever.

Dr. *Fuller* presents us with two or three good Aphorisms, or general Maxims, for Contrivance in *Building*, which are as follow:

First, Let not the common Rooms be several, nor the several Rooms common; that the common Rooms should not be private or retired, as the Hall, (which is a *Pandochæum*;) Galleries, &c. which are to be open; and the Chambers, Closets, &c. retired and private, provided the whole House be not spent in Paths.

Light (God's eldest Daughter) is a principal Beauty in a *Building*; yet it shines not alike from all Parts of the Heavens.

An East Window gives the Infant Beams of the Sun, before they are of Strength to do any Harm, and is offensive to none but a Sluggard.

A South Window, in Summer, is a Chimney with a Fire in it, and stands in need to be skreen'd by a Curtain.

In a West Window, the Sun grows low, and ever familiar towards Night in Summer-Time, and with more Light than Delight.

A North Window is best for Butteries and Cellars, where the Beer will be sour, because the Sun smiles upon it.

Thorough Lights are best for

Rooms of Entertainment, and Windows on the Side for Dormitories.

Secondly, As to Capaciousness: A House had better be too little for a Day, than too big for a Year; therefore Houses ought to be proportion'd to ordinary Occasions, and not to extraordinary. It will be easier borrowing a Brace of Chambers of a Neighbour for a Night, than a Bag of Money for a Year: Therefore 'tis a Vanity to proportion the Receipt to an extraordinary Occasion; as those do, who by overbuilding their Houses, dilapidate their Lands, so that their Estates are pressed to Death under the Weight of their House.

Thirdly, As for Strength: Country-Houses must be Substantives, able to stand of themselves, not like City *Buildings*, supported and flanked by those of their Neighbour, on each Side.

By Strength, is meant such as may resist Weather and Time, but not Attacks; Castles being out of Date in *England*, except on the Sea-Coasts, &c.

As for Motes round Houses: 'Tis questionable whether the Fogs that arise from the Water, are not more unhealthful than the Defence that the Water gives countervails, or the Fish brings Profit.

In working up the Walls of a *Building*, let not any Wall be work'd up above three Foot high, before the next adjoining Wall be brought up to it, that so they may be joined together, and make good Bond in the Work. For some Bricklayers have an ill Custom of carrying or working up a whole Story of
the

the Party-Wall, before they work up the Fronts, or other adjoining Work, that ought to be bonded or work'd up together with them, which is often the Cause of Cracks, and Setlings in the Walls of the *Building*, which very much weakens it.

The Strength of a *Building* is sometimes much impair'd by the erecting it, by Reason of the Masters not having prepared either sufficient Materials, or Money, before he set about *building*. For when *Buildings* are erected by Fits and Pauses, by doing first one Piece, and then another, the Work dries, and sinks unequally; by which Means the Wall becomes full of Chinks and Crevices: And therefore this Way of *building* by Fits, is condemn'd by all Authors.

Fourthly, As for Beauty: Let not the Front look asquint upon a Stranger, but accost him right at his Entrance. Uniformity and Proportion are very pleasing to the Eye. And 'tis observable, that Freestone, like a fair Complexion, grows old, whilst Bricks keep their Beauty longest.

Fifthly, Let the Offices keep their due Distance from the Mansion-House; those are too familiar which presume to be of the same Pile with it.

The same may be said of Stables and Barns; without which, a House is like a City without Works: It can never hold out long.

It is not only very inconvenient, but rather a Blemish than a Beauty to a *Building*, to see the Barns and Stables too near the House; because Cattle, Poultry, and such like, must be kept

near them; which will be an Annoyance to an House.

Gardens ought also to be disposed in their proper Place. When God planted a Garden Eastward, he made to grow out of the Ground every Tree pleasant to the Sight, and good for Food. Sure, (says Dr. Fuller) he knew better what was proper to a Garden, than those who now-a-days only feed their Eyes, and starve their Taste and Smell.

Mr. Worlidge advises, that the Garden join to one, if not more Sides of the House. For what can be more pleasant and beautiful for the most Part of the Year, than to look out of the Parlour and Chamber-Windows into Gardens.

For Beauty, says he, let there be also Courts or Yards kept from Cattle, Poultry, &c. and planted with Trees, to shade, defend, and refresh your House; and the Walls also plauted with Vines, and other Wall-Fruit: All which will add Pleasure and Beauty to your Habitation.

In Architecture, says a certain Author, there seems to be two opposite Affectations, viz. Uniformity and Variety: Yet these seeming Opposites may be very well reconciled; as may be observ'd in our own Bodies, the great Pattern of Nature; which is very uniform in the whole Configuration, each Side agreeing with the other in Number, Quality, and the Measure of the Parts: And yet some are round, as the Arms; others flat, as the Hands; some prominent, and others indented or retir'd. In like Manner, the Limbs or Members of a noble Fabrick may be

be correspondent enough, altho' they be various, provided Persons do not run out into extravagant Fancies, when they are contriving how to divide and cast the Work.

Enormous Heights of six or seven Stories are to be avoided, as well as irregular Forms; and so on the contrary, should low distended Fronts, they being unseemly. And again, when the Face of a *Building* is narrow, and the Flanks deep.

As to the modern Way of *building* in *England* compar'd to the antient:

In comparing the modern *English* Way of *building* with the old, one cannot but wonder at the Genius of those Times. Nothing is, or can be more pleasant than Height; nor any Thing more conducive to Health, than a free Air: And yet in old Times, they were wont to dwell in Houses, most of them with a blind Stair-Case, low Ceilings, and dark Windows; the Rooms built at Random, without any Thing of Contrivance, and often with Steps from one to another; as if the People of former Ages were averse to Light and good Air; or were pleas'd with playing at Hide-and-seek.

Whereas on the contrary, the the Genius of our Times is altogether for light Stair-Cases, fine Sash-Windows, and lofty Ceilings.

And such has been of late the Industry of our Builders, in relation to Compactness and Uniformity, that a House, after the new Way, will afford as many more Conveniencies, upon the same Quantity of Ground.

The Contrivance of Closets, in most Rooms and painted Wainscot, now in so common Use, are likewise two great Improvements, the one for Convenience, and the other for Cleanliness and Health: And, indeed, for so damp a Country as *England* is, nothing could be better contriv'd than Wainscot, to ward off the moist Effluvia of damp Walls.

In a Word, for handsome Accommodations, and Neatness of Lodgings, *London* has undoubtedly gain'd the Pre-eminence of all Places in *Europe*.

The greatest Objection against the Houses in the City of *London* (being for the most part of Brick) is their Slightness, occasion'd by the Fines exacted by the Landlords.

So that few Houses, at the common Rate of *Buildings*, last longer than the Ground-Lease; and that is commonly about fifty or sixty Years. And if there happens to be a long Continuance of excessive Heat in Summer, or of Cold in Winter, (though, indeed, those Extrems happen but seldom with us,) the Walls being thin, become at last so penetrated with the Air, that it must needs make the Inhabitants uneasy.

But then this Manner of *building* is very much to the Advantage of Builders, and such Trades as have Relation to them; for they scarce ever want Work in so large a City, where Houses are here and there always either repairing or rebuilding.

Again, the Plaister'd Ceilings, which are so much more used in *England*, than in other Countries,

tries, do, by their Whiteness, make the Rooms much lighter, and are also excellent against the Ravages of Fires; they also stop the Passage of the Dust, and lessen Noise over Head, and render the Air something cooler in Summer-Time, and warmer in Winter, because they keep out cold Air better than Boarded Floors alone can do.

Dr. Fuller says, he who alters an old House, is ty'd as a Translator to the Original, and is confin'd to the Fancy of the first Builder. Such a Man would be unwise to pull down a good old Building, perhaps, to erect a worse new one. But those who erect a new House from the Ground, are worthy of Blame, if they make it not handsome and useful, when Method and Confusion are both of a Price to them.

I shall here propose a cheap Contrivance in *building*, which some approve of, *viz.*

Raise the Walls with Bricks, where Bricks may be had, making firm and strong Quoins, at the Corners of the House, of sufficient Strength to support the Floors and Roof, or the main Beams of it; the Walls may be built square, and the Walls between them, built of the same Materials, and work'd up together with the Quoins, leaving one Half of the extraordinary Breadth of the Quoins without, and the other, within the Wall, whereby there will be much Charge sav'd, both in Materials and Workmanship, and yet the *Building* be firm and strong.

VOL. I.

Some General Rules to be observed in building.

These which follow, were establish'd by Act of Parliament, before the *Rebuilding* of the City of London after the Fire.

First, In every Foundation within the Ground, you must add one Brick in Thickness to the Thickness of the Wall next the Foundation to be set off, in three Courses equally on both Sides.

Secondly, No Timber must be laid within twelve Inches of the Foreside of the Chimney-Jaumbs.

Thirdly, That all Joists on the Back of any Chimney, be laid with a Trimmer at six Inches Distance from the Back.

Fourthly, That no Timber be laid within the Funnel of any Chimney, upon Penalty of ten Shillings to the Workman, and ten Shillings every Week it continues unreform'd.

Fifthly, That no Joists or Rafter be laid at greater Distances from one to the other, than twelve Inches; and no Quarters at greater Distance than fourteen Inches.

Sixthly, That no Joists bear at longer Length than nine Foot.

Seventhly, That all Roofs, Window-Frames, and Cellar-Floors be made of Oak.

Eighthly, That the Tile-Pins be made of Oak.

Ninthly, That no Summers or Girders in Brick Buildings, do lie over the Heads of Doors or Windows.

Tenthly, That no Summers or Girders do lie less than ten Inches into the Brickwork ; nor no Joists less than eight Inches, and that they be laid in Lome.

Also some advise that all Tarsels for Mantle-Trees to lie on, or Lintels over Windows, or Templers under Girders, or any other Timber, which must lie in the Wall, be laid in Lome, which is a great Preserver of Timber ;

whereas Mortar eats and corrodes it.

Some Workmen pitch the Ends of Timber which lie in the Walls, to preservethem from the Mortar.

As to the surveying of *Building*, I shall touch briefly on it. As to the Method by which the Manner and Form of taking Dimensions, will appear, that is, as follows :

The SURVEY of a BUILDING erected by HENRY GAINES, for Mr: WILLIAM BLAKEWAY. The Thickness of the Walls (as by Agreement.) Brick and half, at 3l. per Rod. For Mortar and Workmanship, the Dimensions were taken as follows:

	Feet. Parts.				
1. The Length of one Side	40	50	}	648 0	
From the Foundation to the Raifing	16	00			
2. The Breadth at one End	17	16	}	283 14	
The Height to the Cross-Beam	16	50			
3. A Partion-Wall within	17	16	}	180 18	
Height to the First Story	10	50			
4. The Length of the other Side	39	33	}	275 31	
From an old Wall, to the Raifing	7	00			
5. The Breadth at the other End	17	00	}	82 11	
From the Floor, to the Cross-Beam	4	83			
6. A Water-Table, 30 Foot reduced to	10	7	}	23 70	
From the Foundation, to the Table	3	16			
7. A Setting off on the other Side of the	}	16	83	}	16 83
House					
8. A Gable End		66	7	66 0	
The total Area or Content of these	}	1575 27			
Dimensions					

Particulars to be deducted.

		<i>Feet.</i>	<i>Parts.</i>	
1. One Door-Cafe	Broad	8	66	} 81 58
	High	9	42	
2. Another Door-Cafe	Broad	4	33	} 32 13
	High	7	42	
3. A third Door-Cafe	Broad	4	33	} 22 34
	High	5	16	
4. A Window-Cafe	Broad	4	50	} 20 25
	High	4	50	
5. Another Window-Cafe	Broad	4	50	} 20 25
	Deep	4	50	
The Total of these Deductions		176	55	
Taken from the whole Content		1575	27	
There remains due		1398	72	

Which reduced into square Rods, is five Rods, thirty-eight Feet ; and so, according to the Contract, there will be due to the Brick-layer 15*l.* 8*s.* 3*d.*

Mr. *Ven. Maudey* gives us the following Method of surveying *Buildings*, and taking Dimensions, and setting them down in a Pocket-Book.

2. Before you begin to set down the Dimensions, it will be proper to divide the Breadth of the Page into so many several Columns as you shall think you shall have Occasion for, either with Lines drawn with Ink, or a Pencil. Your Pocket-Book should be of the broadest Size, *viz.* four Inches broad ; which may be divided into four Columns.

2. Before you set down any Dimensions, you must first set down the Names of the Masters of the Work, and the Work-

men ; also the Place where, and the Day of the Month, and Date when you measure.

As for Example: Suppose you are to measure Glaziers Work :

Then you must observe, if it were glazed with square Glafs, you must write Squares over the Dimensions ; and if there is any Part or all in Quarry-Glafs, you must write *Quarries* ; that when you come to make the Bill of Measurement, you may express them severally ; because they are of several Prizes.

For the clearer Understanding of this, I shall give you this Bill of Measurement of Glaziers Work, as follows:

B U

Squares.			Products.		
F.	I.	P.	F.	I.	P.
5	8	6}	31	11	30
5	7	6}			
5	3	6}	12	6	0
2	4	6}			
2	6	0}	(3)	8	9 0
1	2	0}			
2	1	0}	(2)	7	2 4
1	8	6}			
			60	5	11

B U

Squares.			Products.		
F.	I.	P.	F.	I.	P.
4	3	0}	4	11	6
1	2	0}			
2	0	0}	3	5	0
1	6	0}			
6	0	9}	3	5	3
5	0	3}			
1	2	0}	(2)	7	0 0
3	0	0}			
			45	4	9

An Explanation of the Column.

In the first Column, towards the Left Hand, are the Dimensions of Glazings done with Quarrels; which are to be cast up by Crofs Multiplication. See MULTIPLICATION.

In the second Column, are the Products of each Dimension just against it:

In the third Column, you have the four Dimensions of Glazing done with Squares; and in the last, you have the Product of each Dimension just against it.

At the Bottom of the second Column, you have the Sum total of the Products of the Dimensions done with Quarrels, which is 60 Feet, 5 Inches, and 11 Parts.

At the Bottom of the last Column, there is the total Sum of the Products of those Dimensions of the Glazing that was done with Squares, which is 45 Feet, 4 Inches, and 9 Parts: As for the odd Parts, they signify but little; if they be left out in the Sum total of Measurement,

they amount to but very little in Value, unless there be many and large Articles of them to be added together.

N. B. When you are taking Dimensions, and setting them down in your Pocket-Book, whether of the Work of a Glazier, Carpenter, Bricklayer, &c. you must remember to leave every other Column vacant, that when you have set down all the Dimensions in the Book, (which is to be done before you cast any up, and which is to be done in another Book, or Sheet of Paper,) the Product of each Pair of Dimensions may be entered down just against them, as is to be seen in the foregoing Examples.

If there be another Person to measure against you, and there should happen a Mistake in either of your Castings up, this should be corrected by one Reading over the Dimensions to the other looking on his Book, that the Error may be found out and rectify'd, that both the Accounts may agree exactly together.

When

When you make your Bill of Measurement, you must set your Name to it, at the lower End of the Bill.

An Example of a Bill of Measurement.

*Glaziers Work done for A. B. of Stepney, by C. D. of Ratcliff.
Measured June 22, 1733.*

For sixty Foot five Inches of Glazing done with } Quarrels, at 5 d. per Foot	1 5 1 $\frac{1}{4}$
For forty-five Feet and four Inches of Glazing } done with Squares, at 7 d. per Foot.	1 6 2 $\frac{1}{4}$

<i>Measured the Day and Year</i> <i>abovewritten, by E. F.</i>	Sum total is	2 11 3 $\frac{1}{2}$
---	--------------	----------------------

The Method of taking the Dimension of Bricklayers Work, which is the most troublesome of the Work of any Artificer concern'd in *Building*; I shall give an Instance of it

Although I before advised to divide the Page of your Measuring Book into four Parts, or Co-

lumns, yet in the Mensuration of Bricklayers Work, it will not be necessary to divide the Page into any more than three Columns; one large, for the Appellations, and two smaller, for the Dimensions; the other for the Products :

As in this Example following :

<i>Appellations</i>	<i>Dimen.</i>	<i>Products.</i>
	<i>Br. 3</i>	<i>Br. 3</i>
	<i>Ft. In.</i>	<i>Ft. In.</i>
Basis of the Front and Rear	$\left\{ \begin{array}{l} 25 \ 0 \\ 0 \ 6 \end{array} \right\}$	(2) 25 0
	<i>Br. 2 $\frac{1}{2}$</i>	<i>Br. 2 $\frac{1}{2}$</i>
Front and Rear	$\left\{ \begin{array}{l} 25 \ 0 \\ 11 \ 0 \end{array} \right\}$	(2) 55 0
	<i>2 Br. $\frac{1}{2}$</i>	<i>2 Br. $\frac{1}{2}$</i>
Basis of both the Flank-Walls	$\left\{ \begin{array}{l} 36 \ 2 \\ 0 \ 6 \end{array} \right\}$	(2) 36 2

B U

B U

<i>Appellations.</i>	<i>Dimen.</i>	<i>Products.</i>
	2 Br.	2 Br.
		<i>Ft. In.</i>
	2 Br.	2 Br.
Both the Flanks	$\left\{ \begin{smallmatrix} 36 & 2 \\ 11 & 0 \end{smallmatrix} \right\} (2)$	795 8
	1 Br. $\frac{1}{2}$	1 Br. $\frac{1}{2}$
The Wall between the Chimneys	$\left\{ \begin{smallmatrix} 11 & 6 \\ 9 & 10 \end{smallmatrix} \right\} (2)$	113 1
	1 Br.	1 Br.
The Falling-back of both Chimneys	$\left\{ \begin{smallmatrix} 5 & 0 \\ 4 & 0 \end{smallmatrix} \right\} (2)$	40 0
	2 Br.	2 Br.
The four Jaumbs	$\left\{ \begin{smallmatrix} 14 & 0 \\ 11 & 0 \end{smallmatrix} \right\} (2)$	161 0
	2 Br.	2 Br.
The Fore-Part or Breasts of both Chimneys	$\left\{ \begin{smallmatrix} 11 & 6 \\ 5 & 0 \end{smallmatrix} \right\} (2)$	115 0

Having set down the Dimensions with their Products, you must in the next Place set down the Deductions for the Windows and Doors, with their Products.

The Deductions.

<i>Appellations.</i>	<i>Deduct.</i>	<i>Products.</i>
	2 Br. $\frac{1}{2}$	2 Br. $\frac{1}{2}$
		<i>Ft. In. Ft. In.</i>
The four Windows	$\left\{ \begin{smallmatrix} 6 & 6 \\ 4 & 0 \end{smallmatrix} \right\} (4)$	104 0
	2 Br. $\frac{1}{2}$	2 Br. $\frac{1}{2}$
The two Doors	$\left\{ \begin{smallmatrix} 6 & 0 \\ 4 & 0 \end{smallmatrix} \right\} (2)$	72 0

The

The next Thing you have each several Thickness of the to do, is, to add the Products of Sum.

The Products of the several Thicknesses.

3 Br.	2 $\frac{1}{2}$ Br.	2 Br.	1 $\frac{1}{2}$ Br.	1 Br.
25 0	$\begin{array}{r} 555 \ 0 \\ 36 \ 2 \\ \hline 586 \ 2 \end{array}$	$\begin{array}{r} 755 \ 8 \\ 161 \ 0 \\ \hline 115 \ 0 \end{array}$	$\begin{array}{r} 113 \ 1 \\ \hline \end{array}$	$\begin{array}{r} 40 \ 0 \\ \hline \end{array}$
		1071 8		

The several Products of each Thickness being added, in the first column on the Left Hand, is 25 Feet of three Bricks. In the second, 586—2 of 2 $\frac{1}{2}$ Bricks, &c.

Now to find these Products, see *Cross Multiplication*, N. 2.

Having found the total Sum of the Products of the Deductions, each total Sum must be subtracted from the total Sum of the Products of the Dimensions that are of the same Thickness.

The Front and Rear were taken, the Whole Length was taken over the Doors and Windows, not allowing an Abatement for them.

N.B. Whatsoever Doors or Windows, or any other Vacancies, are measured over when the Dimensions were taken, you must remember to deduct them out of the whole Product of the Dimensions of the same Thickness, wherein they were situated.

E. gr. The Deductions } 2 $\frac{1}{2}$ Br.
in ————— }
104 00
73 00
—————

The Total Product in } 176 00
2 $\frac{1}{2}$ Br. is ————— }

Which 176 Feet of 2 $\frac{1}{2}$ Brick-work, being contained in the Windows and Doors, must be subtracted from the 586 Feet 2 Inches, being the total Product of all the Dimensions of that Thickness, viz. 2 $\frac{1}{2}$ Bricks, viz. 2 $\frac{1}{2}$ Brickwork.

This is manifest to Reason, because when the Dimensions of

In order to render this plainer, take the following Example :

The Doors and Windows being in 2 $\frac{1}{2}$ Brick-Work, you must set down the total Product of all the Dimensions of that Thickness, which is — 586 02

The Total Product of all the Deductions of that Thickness, which are to be subtracted, is ————— } 179 00

The Remainder is 410 02

The like must have been done, if there had been any other Deductions

ductions in any other Thick-
nesses: All such Deductions must
have been subtracted from the
Products of the Dimensions,
before you went about to re-
duce your Thicknesses to the
Standard Thickness of a Brick
and half.

More of this Nature, *viz.* of
surveying *Buildings*, or taking
Dimensions, &c. may be seen
under the Heads Carpenters
Work, Joiners, Bricklayers,
Plasterers, Masons, Painters,
Thatchers, &c.

Of measuring Buildings.

I shall in this Place only mention
the Artificers relating to *Build-
ing*, who usually work by Mea-
sure; which are, *First*, Brick-
layers; *secondly*, Carpenters;

thirdly, Plasterers; *fourthly*,
Painters; *fifthly*, Glaziers; *sixth-
ly*, Joiners; and *seventhly*, Ma-
sons.

Some of which work by the
superficial Yard, some by the
Rod, some the Square, and
some by the Foot: Of all which
Works the Dimensions are taken
either with a ten-foot Rod, or a
five-foot one; or else with a
two-foot Rule, and sometimes
with a Line.

But however the Dimensions
are taken, they are generally
set down in Feet, Inches, and
Parts of Inches; or else in Feet,
and centesimal Parts of Feet;
which last Way is the easiest cast
up: And as to the Centesimal,
i. e. hundredth Parts, the follow-
ing Table will shew them.

A TABLE

A TABLE of Centesimal Parts for every Inch, and quarter of an Inch, in a Foot.

		1 Quarter of an Inch.	2 Quarters of an Inch.	3 Quarters of an Inch.
Inches.	100 Part of a Foot.	100 Part of a Foot.	100 Part of a Foot.	100 Part of a Foot.
0	. 00	. 02	. 4	. 06
1	. 08	. 10	. 12	. 12
2	. 16	. 18	. 20	. 22
3	. 25	. 27	. 29	. 31
4	. 33	. 35	37	39
5	. 42	. 44	45	47
6	. 50	. 52	53	55
7	. 56	. 60	62	64
8	. 66	. 68	70	72
9	. 75	. 77	79	81
10	. 83	. 85	87	40
11	. 92	. 94	96	98
1 Foot.	. 100			

To set down any Number of Feet, Inches, and Parts; as suppose 40 Feet, 6 Inches, and 3 quarters; you must first set down 40 Feet with a Period or Comma after it thus, 40, and then look in the first Column for 6 Inches, and at the Head of the Table for 3 Quarters, you will find 55; which set down beyond the 40 to the Right Hand, and it will stand thus, 40, 55.

Of the valuing of Buildings.

In order to the estimating the Charge of erecting any House, as near as can be, or to value one that is already built, to come pretty near the Truth, provided it be built of Brick and Timber.

1st, Find the Dimensions in Length, Breadth, and Height, in respect to the Number of Stories.

2^{dly}, By the Length and Breadth, the Quantity of Squares upon each Floor may be found; and also the Squares of Roofing in Carpenters Work, and also of Tiling in Bricklayers Work.

3^{dly}, By the Height you may give a near Estimate of the Rows of Brickwork contain'd in the Walls round about, and in the Partition Walls, if there be any; and also in the Chimneys. Then,

4^{thly}, Consider how many Pairs of Stairs, and of what Sort.

5^{thly},

5thly, What Number of Partitions of Timber, with Doors.

6thly, What Timber Front,

7thly, What Number of Window Frames, and Lights.

8thly, What Iron Work.

9thly, What Lead, &c.

Of which see the particular Heads

Mr. *Leybourn* puts the Question, What will be the Charge

of erecting a *Building* of Brick Walls and Timber, which shall be 20 Feet in Front, and 44 deep, and for the Front to be shorter than the Flanks, and to consist of Cellars, three Stories, and Garrets, which is one of the second Rate Houses. Now supposing the Price of Materials (in *London*) to be as follows, viz.

			<i>l.</i>	<i>s.</i>	<i>d.</i>
For	{	Bricks <i>per</i> Thousand	—	00	16 00
		Tiles <i>per</i> Thousand	—	01	05 00
		Lime <i>per</i> Hundred	—	00	10 00
		Sand <i>per</i> Load	—	00	03 00
		Oak or Fir Timber <i>per</i> Load	—	02	15 00
		Deal Boards <i>per</i> Hundred	—	07	10 00
		Laths <i>per</i> Bundle	—	00	01 06

As for Plasterers Work.

			<i>l.</i>	<i>s.</i>	<i>d.</i>
For	{	Lathing, Plastering, Rending, and Washing	—	00	01 02
		with White and Size, <i>per</i> Yard	—	00	00 10
		Plastering and Sizing <i>per</i> Yard	—	00	00 06

Smiths Work.

			<i>l.</i>	<i>s.</i>	<i>d.</i>
For	{	Iron for Balconies <i>per</i> lb.	—	00	00 05
		Folding Casements <i>per</i> Pair	—	00	16 00
		Ordinary Casements <i>per</i> Piece	—	00	04 06

For Painting.

			<i>l.</i>	<i>s.</i>	<i>d.</i>
Window Lights	—	—	00	00	06
Shop Windows, Doors, Pales, <i>per</i> Yard	—	—	00	01	00

Now, says he, from these Rates of Materials for *Building*, and for Workmanship, such a House will amount to about 360*l.* which is about 41*l.* *per* Square.

Mr. *Phillips* proposes the following Method to find the Value of a *Building*, viz. Suppose

a House to be one Rod, or sixteen Feet and a half in Front, and two Rods deep, back in the Flanks, the Compass of this House will be six Rods: And if this House stands in a high Street, having a Cellar, four Stories, and a Garret, (which is one of the third

third Rate Houses,) the Height thereof will be fifty Feet, or three Rods; so that there will be eighteen Rods of Brickwork in the Walls, which may all be reduced to a Brick and a half thick, and (supposing each Rod of Brickwork to contain 4500 Bricks,) will cost about 7*l.* the building, *viz.* Bricks, Mortar, and Workmanship; then the whole eighteen Rods of Brickwork will cost about 126*l.*

The Timber Work for Floors, Windows, Roofs, &c. about as much more.

The Tiling, Plastering, Lead, Glazing, and Painting will be about as much more; so that the Whole will amount to 378*l.*

The Allowance for the Party-Walls will very well pay for the Chimneys; so that this House cannot amount to above 400*l.* the building, which is not full 13*l.* *per* Square: But this is a very great Price, in comparison of Mr. *Leybourn's*; but he says it will be worth more or less, according to the Market Price of the Materials.

The *Friendly Society* of *London* for insuring Houses, have two Rules by which they value them, *viz.* Either by the Rent, or Number of Squares contained on the Ground-Plot.

The last is the general Rule by which they value all *Buildings*; which is grounded on an Act of Parliament for rebuilding the City of *London*, made about *Anno* 18. *Car.* II.

The *Buildings* of the City of *London* are valued according to their Rates, of which Rates there are four, *viz.*

First Rate	2	} Stories, Cellars, and Garrets.
Second Rate	3	
Third Rate	4	
Fourth Rate	5	

And the naked *Building* or Shell of a Brick House (the Floors being finished) is thus valued, by the Square or 100 Feet in the High-Streets, *viz.*

First Rate	25 <i>l.</i>	} <i>per</i> Square.
Second Rate	35 <i>l.</i>	
Third Rate	45 <i>l.</i>	
Fourth Rate	50 <i>l.</i>	

But these may be augmented at the Discretion of the Surveyor, or according to the finishing of the House.

Vitruvius, *Lib.* 1. *Cap.* 2. determines six Considerations, in order to the judging or censuring of a *Building*, *viz.*

1. *Ordination.* 2. *Disposition.*
3. *Eurythmy.* 4. *Symmetry.* 5. *Gracefulness.* 6. *Distribution.*

The two first of these might have been very well spared, since he seems to mean no more by *Ordination*, than but a well-settling the Model or Scheme of the whole Work; nor any Thing by *Disposition*, but a neat and full Expression of the first Idea and Design of the *Building*, which seems more properly to belong to the Artificer than the Censurer.

The other four are sufficient to approve or condemn any *Building* whatsoever.

Eurythmy is that agreeable Harmony which is between the Length, Breadth, and Height of all the Rooms of the *Building*, which will be very pleasing to Beholders;

Beholders; which is always so to all, by a secret Power, that is in Proportion.

Here it may be proper to observe, that though Excess of Height is the least Error of Offence that can be committed against the Sight; yet even that Error is no where of small Importance, because it is the greatest Trespas upon the Purse.

Symmetry, which is a due Proportion of each Part, in respect to the Whole; whereby a great *Building* should have large Apartments or Rooms, great Lights or Windows, great Stair-Cases, great Pillars or Pilasters, &c. In short, all the Members and Parts large, in Proportion to the *Building*.

For as it would be but an odd Sight to see a large Man with little Legs, Feet, Arms, Hands, &c. so also would it be uncomely to see a large *Building* consisting of little Apartments, Lights, Stair-Cases, Entrances, &c. and so, on the contrary, it will be as odd to see a little Man with large Limbs; the same will it be in a small *Building* so contrived, as to have large Rooms, large Stair-Cases, large Lights, large Entrances, &c.

But again, as it is an unbecoming Sight to see either a great or little Man with some of his Limbs or Parts proportionable to his Body, and others some so little, as if they did belong to a Pigmy; and others so large, as if they did belong to a Giant: So would it be equally as ugly and offensive to the Sight, to see a small House have some of its Parts monstrous, viz. large in some Parts of the Apartments,

and by consequence others must be as small, or else some must be annihilated, and so consequently will be wanting; or large Stair-Cases, large Windows, and large Doors, or any other Parts larger than they ought to be, in respect to the Symmetry of the Parts with the Whole.

It is likewise unseemly to see some of the Parts too little, and not proportionable to the whole Structure, as to see a Man with one leg proportional to his Body, and the other very small, or to have one Eye of a Man, and the other of a Bird.

Many Errors are committed by Workmen in Symmetry, for want either of due Consideration, or Skill.

Sometimes it may be observed in the Course of censuring, that a Door or Chimney has been so misplaced, either to the Right or Left, as to spoil the intended Use of a Room: And though sometimes it is not totally spoiled, yet it shews the want of Contrivance in the Artificer.

Sometimes you may observe a Chimney so situated in the Angle of a Room, (which though it was designed for Convenience, because it could not well be carried up otherwise from the Chimney below it,) yet this Chimney shall in some measure spoil the intended Use of two Rooms, viz. that in which the Chimney is, and the next adjoining to the Chimney Jaumb. Thus two Chambers have been in great measure spoiled by a Chimney being set in the Angle of the inner one, the Door coming into it from the Chamber without, just by one Jaumb, and of consequence

sequence that whole Chimney was carried a Foot too far out in the Room, which might as well have been carried farther the other Way, by which Means the Door was placed too far towards the other Wall; so that the Partition Wall, by this Means, was made so narrow between the other Wall and the Door, (at the Chimney Jaumb,) that it was thereby rendered unfit to set a Bed in against it, though it was the fittest Place in the Room for that Purpose.

Sometimes little diminutive Stair-Cases are made in a handsome spacious Structure; and, on the contrary, in a small or middling House, Stair-Cases so large, that if you see them before any other Apartment, you might well conjecture that the Rooms of that *Building* were proportionable to the Stair-Case, twice or three Times larger than you find them.

Nay, perhaps this shall not be all the Error; for these Guess-Workmen do so manage the Matter, as to spoil the Conveniences of Closets under them, (for any other Convenience;) though it be now the Fashion to make some little Conveniences under a Stair-Case; for Closets are accounted an Improvement in our Way of *Building*.

Sometimes you may observe an ill Position of Lights, (or Windows) to a Stair-Case, not out of Necessity, but Want of Skill and Contrivance.

And again, as to Lights, (or Windows,) you will sometimes see an ill Position, as well as an irregular Disposition in them, *viz.* either in regard to Unifor-

mity, or as to securing them from the Weather; that is, when they are placed too near the Surface of the *Building*, that the Walls do not project over them, the better to carry the Wet from them, which runs down the Walls in stormy Weather.

And then again, as to Uniformity in placing them, it sometimes so happens, that they cannot place them on the Garrets exactly over those in the Stories below; and therefore when they will not be brought into Uniformity with those below them, they ought to be placed as uniformly as possibly can be within themselves.

This has been observed in a Fabrick which stood in the Form of a Roman Capital L, having two Fronts on the Outside of the L, confronting two Streets which cross one another at Right Angles: The Foot or short Part of the L in the *Building*, was not so wide, but that it might be spanned by one Roof; but the long Part was too wide to be spanned by one Roof, unless it were carried up a great deal higher than the other Part, which would have been very unsightly: And therefore, three Roofs were set on the long Part of the L, parallel with that on the short Part; so that there were three Gutters, and four Gable-Heads, on that Part which was the long Part of the L; and in each of these Gable-Heads, there was a Window.

Now according to the Divisions of the Apartments in the Stories below, the Windows in them would not fit, to be placed (any of them) perpendicular under the Middle of these Gables, the

the Workman thinking to render it something nearer to Uniformity, places three Fourths of these Windows all towards, nay, very near one Side of the Gables, pretending, they were without Doubt, nearer directly over the others; and therefore it was nearer to Uniformity, whereas at the same Time, they are farther from it: For by this Means they are not in an uniform Position, neither in respect to the Stories below them, nor yet within themselves; which last they would have been, if they had been placed in the Middle of each Gable, and would have been more decent and handsome, both with Regard to the Front without, and the Room within.

These, and many more are the Blunders committed for want of Contrivance or a good Judgment as to Symmetry. I shall only add, that it ought to be observed, whether Doors have their due Symmetry as to their Dimensions, as well as their Positions, viz. That they be not too high, as if they were for a Barn, nor too low, as if they were made for Houses in *Sophia* in *Bulgaria*; where both Jews and Christians have their Doors of their Houses but a little above three Foot high; which are therefore so contriv'd, because the *Turks* should not bring in their Horses; which they would do, and make use of them for Stables in their Travels, if it were not for this Contrivance. This, as well as all other Parts of a *Building*, ought to be analogous to the rest of the *Fabrick*. I shall next speak of

Decor or Becomingness, or rather Suitableness; which is the keeping a due Respect between the Inhabitant and the Habitation. Whence *Palladio* concludes, that the principal Entrance was not to be regulated by any certain Dimensions, but by the Dignity of the Master; yet to exceed rather in the more, than in the less, is a Mark of Generosity, and may always be excused with some noble Emblem or Inscription.

Distribution, is that useful Casting, or Contriving of all Rooms for Office, Entertainment or Pleasure, which has been already sufficiently treated of under this Head of *Building*.

These are the four general Heads which every Man ought to run over, before he pretends to pass his Judgment upon a *Building*, or undertakes to censure a Work that he views.

Dr. *Fuller* advises rather to believe any Man than an Artificer in his own Art, as to the Charges of a *Building*, especially, if either himself, or any Friend of his, is to be concern'd in the *Building* that is designed to be erected: Not but that Builders can tell nearly the Charge, when they know the Design, but it is very rare that they will give a just Estimate of it according to their Judgment; because they think if they should acquaint a Gentleman with the full Expence at first, it would discourage him from prosecuting it; and for that Reason, they soothe him up, 'till it will cost him something considerable; after which, he must go through with it, or lose what has been expended.

The

The Spirit of *Building* first possess'd People after the Flood; which then caused the Confusion of Languages, and since, the Confusion of many a Man's Estate: And hence, when some Persons would wish a Curse upon one with whom they are angry, they wish them to be possessed with the *Spirit of Building*, or, as others term it, the *Italian Plague*.

BUST, ♀ in Sculpture, &c.

BUSTO, ♂ is a Term used for the Figure or Portrait of a Person in Relievo, shewing only the Head, Shoulders, and Stomach, the Arms being lopped off; which is ordinarily placed on a Pedestal or Console.

Felbien observes, that though in Painting, one may say, a Figure appears in *Busto*, yet it is not proper to say, in a *Bust*. The *Bust* is the same with that the *Latins* call *Herma*, from the *Greek Hermes*, *Mercury*, the Image of that God being frequently represented in this Manner by the *Athenians*.

Bust is also used, especially by the *Italians*, for the Trunk of a human Body from the Neck to Hips.

BUST, or ♀ a Pyramid, or BUSTUM, ♂ Pile of Wood, whereon the Bodies of the Deceased were antiently placed in order to be burnt.

BUTMENTS, [of *Bouter*, *French*, to abut or terminate any Thing] are those Supporters or Props, on or against which, the Feet of Arches rest. Also little Places taken out of the Yard or Ground-Plot of a House, for a Buttery, Scullery, &c.

BUTTERY, in the Houses of Noblemen and Gentlemen, is the Room belonging to the Butler; where he deposits the Utensils belonging to his Office; as Table-Linnen, Napkins, Pots, Tankards, Glasses, Cruets, Salvers, Spoons, Knives, Forks, Pepper, Mustard, &c.

As to its Position, Sir *Henry Wotton*, says, it ought to be placed on the North Side of the Building, which is designed for the Offices.

We, in *England*, generally place it near the Cellar, viz. the Room commonly just on the Top of the Cellar-Stairs.

BULLEN-NAILS, are a Sort of Nails with round Heads, and short Shanks, lin'd and lacquered. There are several Sizes of them.

They are used in hanging Rooms, setting up Beds, covering of Stools, Chairs, Couches, Desks, Coffers, &c.

BUTTRESS, a kind of Butment built Archwise, or a Mass of Stone, or Brick, serving to prop or support the Sides of a Building, Wall, &c. on the Outside, where it is either very high, or has any considerable Load to sustain on the other Side, as a Bank of Earth, &c.

They are also used against the Angles of Steeples, and other Buildings of Stone, &c. on their Outside and along the Walls of such Buildings, as have great and heavy Roofs, which would be subject to thrust the Walls out, if they were not thick, if no *Buttresses* were placed against them.

Buttresses

Buttresses are also placed for a Support and Butment, against the Feet of some Arches, that are turn'd across great Halls in old Palaces, Abbeys, &c. and generally at the Head of Stone Buildings, when there are large Crocket Windows; and they are also placed for Butments to the Arches of these Windows.

The Theory and Rules of *Buttresses* are one of the *Desiderata* in Architecture; but it is not improbable, but that a sagacious Architect and Mathematician, who would apply himself diligently to examine into the Matter, might bring it within the Bounds of Reason and Rules, whereby it might be known very near, of what Size, and consequently of what Weight, a *Buttress* or Butment ought to be; which must be various, according to the Dimensions and Form of the Arch, and the Weight which is super-incumbent on it.

As to the Weight of the Materials, both on the Arch, and in the *Buttress* or Butment, it is not difficult to calculate. But it may probably be objected, there may be a sensible Difference as to the Strength and Goodness of the Mortar; which may in a Measure compensate for the Weight of the *Buttress* or Butments; for where there is a strong firm Mortar used, of less Weight (or Magnitude,) of Brick or Stone, shall be capable to resist the Pressure of an Arch with its superincumbent Materials, than where the Mortar is bad and weak. To which it may be answered, it would not be difficult to make

Experiments of the Strength of Mortar, both as to the direct and oblique Force, by shoving of it out of its Position, or pulling it the shortest Way from its Adherents, I mean, by lifting it directly up.

It seems to be very feasible, and it would certainly be very useful, to try what Butment would be requisite for Arches of all Dimensions or Forms, whether Straight, Semicircular, Sken or Scheme, or of the Third or Fourth Point, or Elliptical, &c. See the Article BRIDGES.

Dr. Hook, Geometry-Reader in *Gresham College*, in his *Treatise of Helioscopes*, did promise to publish something to the foregoing Purpose, whether he ever did do it, I know not; but what he promised in that Treatise, was as follows: viz. A true Mathematical and Mechanical Form of all manner of Arches, with the true Butment necessary to each of them, a Problem, saith he, which no Architectonick Writer hath ever yet attempted, much less perform'd. A Treatise of this Nature would be extremely useful for the want of a certain Rule in Arching, with its necessary Butment, hath often proved the Ruin of some Structures which have been of no small Charge, as to Bridges, &c.

Of the Price of Building Buttresses.

If this Work be not put out to be done by the Day, it is usually done by the Cubical Foot. Some reckon the Workmanship at two Pence Halfpenny per Cubical Foot, which, reckoning the Materials,

terials and Workmanship may be done for about 6*d.* and 7*d.* a Foot.

C A

CABINET, the most retir'd Place in the finest Apartment of a Building, set apart for writing, studying, or preserving any Thing that is precious. A compleat Apartment consists of a Hall, Antichamber, Chamber, and *Cabinet*, with a Gallery on one Side.

Hence we say, a *Cabinet* of Paintings, Curiosities, &c.

CABLED - FLUTE, such Flutes in Architecture, as are filled up with Pieces in the Form of a Cable.

CALCULATION, the Art of computing several Sums, by adding, subtracting, multiplying, and dividing, &c.

CALIDUCTS, a kind of Pipes or Canals, disposed along the Walls of Houses and Apartments, used by the Antients for conveying Heat to several remote Parts of the House, from one common Furnace.

CALOTTE, in Architecture, a round Cavity, or Depressure, in Form of a Cap or Cup, lathed and plaistered, used to diminish the Rise or Elevation of a moderate Chapel, Cabinet, Alcove, &c. which, without such an Expedient, would be too high for other Pieces of the Apartment.

CAMBER-BEAM, a Piece of Timber in an Edifice, cut Arching, or Archwise, or with

an Obtuse Angle in the Middle, commonly used in Platforms, as Church Leads, and on other Occasions, where long and strong Beams are required. A *Camber-Beam* being much stronger than another of the same Size; and being laid with the hollow Side downwards, (as they generally are) they represent a kind of Arch.

CAMBRING. The Seamen say a Deck lies *Cambring*, when it does not lie level, but higher in the Middle, than at either End.

CAMES, the small slender Rods of Cast Lead, of which the Glaziers make their Turn'd Lead. For their Lead being cast into slender Rods, of twelve or fourteen Inches in Length, are called *Cames*; and sometimes they call each of those Rods a *Came*, which, when it has been afterwards drawn through their Vice, makes their turn'd Lead.

CAMERATED, vaulted, or arched.

CANT, a Term used by some Carpenters of a Piece of Timber, when it comes the wrong Way in their Work, they say, *Cant it, i. e.* Turn it about.

CANTALIVERS, Pieces of Wood fram'd into the Front or other Sides of a House to sustain the Moulding and Eaves over it. These seem, in Effect, to be the same with Modillions, except that the former are plain, and the latter carv'd; they are both a kind of Cartouzes, set at equal Distances, under the Corona of the Cornice of a Building.

As to the Price of making, Mr. *Leybourn* says, they are com-

monly made by the Piece, at different Rates, according to the Curiosity of the Work: And some Workmen say, they have 2s. 6d. for making and carving each. But they will carve them in London for twenty Pence per Piece.

As for their Painting, Mr. *Leybourn* likewise tells us, they are usually painted by the Foot, running Measure, *i.e.* by the Number of Feet in Length only, at different Rates, according to the Curiosity of the Workmanship. And some Workmen say, they have commonly 1s. per Foot for the Cornice, if plain without Carving, and 3s. 6d. per Foot with the *Cantabvers*.

CANTING-STAIRS. See STAIRS.

CANTONED, in Architecture, is, when the Corner of a Building is adorn'd with a Pilaster, an angular Column, Rustick Quoins, or any Thing that projects beyond the Naked of a Wall.

CAPITAL, [of *Caput*, *L.* the Head] is the uppermost Part of a Column or Pilaster, serving as the Head or Crowning thereof, placed immediately over the Shaft, and under the Entablature.

Capital of a Column, is properly that whose Plan is round.

Capital of a Pilaster, is that whose Plan is square, or at least rectilineal.

The *Capital* is the principal and essential Part of an Order of Column, or Pilaster: It is of a different Form in the different Orders; and is that which chiefly distinguishes and characterizes

the Orders. Such of these as have no Ornaments, as the *Tuscan* and *Doric*, are called Capitals with Mouldings, and the rest which have Leaves and other Ornaments, Capitals with Sculptures.

The *Tuscan Capital* is the most simple and unadorn'd: Its Members or Parts are but three, *viz.* an Abacus, under this an Ovolo, or Quarter-Round; and under that, a Neck or Colarino; the Neck terminates in an Astragal, or Fillet belonging to the Fust or Shaft.

M. Le Clerc says, this *Capital* only consists of three Parts, an Abacus, a Quarter-Round or Boulton, and a Gorge or Neck, which terminates under the Quarter-Round in a Fillet; the Astragal underneath belonging to the Shaft.

The Character of the *Capital* whereby it is distinguished from the *Doric*, &c. is, that the Abacus is square, and quite plain, having no Ogee, or other Moulding; and that there are no Annulets under the Ovolo. It is true, Authors do vary a little as to the Character of the *Tuscan Capital*.

Vignola gives the Abacus a Fillet, instead of an Ovolo. *Vitruvius* and *Scamozzi* add an Astragal and Fillet between the Ovolo and Neck: *Serlio*, only a Fillet; and *Philander* rounds the Corners of the Abacus.

In the *Trajan Column* there is no Neck, but the Astragal of the Shaft is confounded with that of the Capital.

The Height of this *Capital* is the same with that of the Base,
viz.

viz. one Module or Semidiameter.

Its projecture is equal to that of the Cincture at the Bottom of the Column, *viz.* five Eighths of the Module.

According to *Vitruvius*, the Height of the *Tuscan Capital* (by the Astragal at Bottom) must be half the Diameter of the Body of the Column below.

And this Height being divided into three Parts; the first and uppermost Part goes to the Abacus (which is a square or flat Moulding;) the second Part goes to the Boultin and Fillet under it; the Boultin is a quarter of a Circle; the Fillet, a narrow flat Moulding; and this Part is subdivided into four Parts; three of which go to the Boultin, and one to the Fillet; and the third and last Part go to the Neck, which is flat and straight.

Again, the Neck is divided into two Parts, one of which is the Breadth of the Astragal under it (which consists of a Semicircle and a Fillet under it.)

The Astragal is again divided into three Parts, of which, two go to the Semicircle, and one to the Fillet.

The Projecture of the *Capital* is to be the half Part of the Diameter of the Body of the Column below.

The Astragal projects in a Square.

Scamozzi makes the Height of the *Capital* by the Astragal at the Bottom, also half the Diameter of the Column below; and this Height being divided into sixty Parts, twenty of them go to the Abacus or Plinth (as he calls it,) fifteen to the Echinus or Half-

Round (which is called the Boultin, by *Vitruvius*,) and five to the Rondel or Bead-Moulding (which is a Semicircle,) three to the List, (which by *Vitruvius* is called a Fillet,) and seventeen to the Neck or Frieze. Again, seven such Parts go to the Rondel of the Astragal, and three to its List.

Palladio also makes the Height of the *Capital* half the Diameter of the Body of the Column below (*viz.* by the Astragal, which is by none of them reckon'd a Part of the *Capital*, though properly speaking, it ought to be so accounted;) and this Height he divides into three equal Parts, the uppermost of which goes to the Abacus (which by him is also called the *Dado* or *Dye*,) the next Part goes to the Ovolo or *Echinus* (which by *Vitruvius* is called the Boultin.) the other Part he divides into seven, one of which he makes the Listella (which *Vitruvius* calls the Fillet) under the Ovolo, and the other six Parts go to the Collarino or Neck (which is also called by him the Hypotrachelium, or Frieze of the *Capital*).

The *Doric Capital* has three Annulets, or little square Members underneath the Ovolo, instead of the Astragal in the *Tuscan*, besides an Abacus, an Ovolo, and a Neck, in common with the *Tuscan*; and a Talon, Cyma, or Ogee, with a Fillet over the Abacus. Authors also vary as to the Characters of this *Capital*.

Palladio, Vignola, &c. put *Roses* under the Corners of the *Abacus*, and in the Neck of the *Capital*.

Vitruvius makes the Height of the *Capital* (by the *Astragal* at the Bottom) equal to half of the Diameter of the Body of the Column below.

And this Height being divided into three Parts, the first and lowermost goes to the Neck, the next to the *Boulton* (under which Term, several Members are comprehended;) and this Part is by him described in two Forms; the first of which is a *Boulton* (as 'tis described before,) and three *Fillet*s under it, and the other is a *Boulton*, and an *Astragal* under it; and this Part is divided into three Parts, two of which go to the *Boulton*, properly so called, and the other to three *Fillet*s, or to the *Astragal*.

The *Fillet*s are all of an equal Size: In the *Astragal*, the *Fillet* is one Third of the whole. The third and uppermost Part of the *Capital* is again divided into three, the two lowermost of which go to the Square, and the other to the *Cymatium* (which is an Ogee with the Hollow downwards,) and a *Fillet* over it.

An Ogee is a Moulding which bears some Resemblance to an S; which *Vitruvius* makes of two quarter Circles joined together; and this *Cymatium* being also divided into three Parts, two of them go the Ogee, and one to the *Fillet*.

The *Astragal* under the *Capital* is equal to one half of the Neck.

Scamozzi makes the *Capital* of the same Height, and divides it into sixty Parts, three of which go to the *Fillet* of the *Cymatium*, five to the Ogee of the *Cymatium*, twelve to the Square, fourteen to the *Boulton*, five to the *Rondel*, and two to the *Fillet* of the *Astragal* under the *Boulton*, and nineteen to the Neck.

The *Astragal* under the Neck contains ten such Parts, six and a half of which go to the *Rondel*, and three and a half to the *Fillet*. These are described according to *Vitruvius's* Terms, *Scamozzi* not mentioning any of them.

Palladio likewise makes this *Capital* of the same Height, as *Vitruvius*, and divides it into three Parts; the uppermost of which, he subdivides into five Parts, two of which he allows to the *Cymatium*, and is subdivided again into three Parts, one of which he gives to the *Listella* or *Annulet*, and which by *Vitruvius* is called a *Fillet*; and the other two to the *Cima recta*, (which is an Ogee, as here described;) and the other three of the first Subdivisions of this Part go to the *Abacus*, which by *Vitruvius*, in this Number, is called the Square.

The second of the three grand Divisions of the *Capital* is subdivided in three Parts, two of which go to the *Ovolo* or *Echinus* (which is by *Vitruvius* called the *Boulton*;) and the other to the *Annulets* under it, which are three, and are all equal.

The third principal *Hypotrachelium* or *Frize* L, (which is by *Vitruvius* called the Neck.)

The

The Astragal under the Neck is as high as all the three Annulets.

The *Ionic Capital* is composed of three Parts: An Abacus, consisting of an Ogee; under this, a Rind, which produces the Volutes or Scrolls, the most essential Parts of this *Capital*; and at the Bottom, an Ovolo or Quarter-Round: The Astragal under that Ovolo belongs to the Shaft: The middle Part is called a Rind or Bark, from its supposed Resemblance to a Bark of a Tree, laid on a Vase, whose Brim is represented by the Ovolo, and seeming to have been shrunk up in drying, and to have been twisted into the Volutes.

The Ovolo is adorn'd with Eggs, as they are sometimes called from their oval Form, the *Greeks* call it *Exuvos*.

The Height of this *Capital*, M. *Perrault* makes eighteen Minutes; its Projecture, one Module, seven Tenths.

The Differences in the Character of this *Capital* flow mostly from the different Management of the Volutes, and consist in this: That in the Antique, and some of the Modern, the Eye of the Volute does not answer the Astragal of the Top of the Shaft, as *Vitruvius*, and some of the Moderns make it: That the Face of the Volutes, which usually makes a Flat, is sometimes curved and convexed so that the Circumvolutions go advancing outwards, as is frequent in the Antique.

2. That the Border or Rim of the Scroll in the Volute, is sometimes not only a plain Sweep, as

it ordinarily is, but the Sweep is accompany'd with a Filler.

3. That the Leaves which invest the Baluster, are sometimes long and narrow, sometimes larger and broader.

4. That the two Faces of the Volutes are sometimes joined at the outward Corner, the Balusters meeting in the inner, to make a Regularity between the Faces on the Front and Back of the Building with those of the Sides.

5. That among the Moderns, since *Scamozzi*, the *Ionic Capital* has been altered, and the four Faces made alike, by taking away the Baluster, and hollowing all the Faces of the Volute inwards, as in the *Composite*.

6. That *Scamozzi*, and some others, make the Volutes to spring out of the Ovolo, as from a Vase, after the Manner of the modern *Composite*: Whereas in the Antique, the Bark passes between the Ovolo and Abacus, quite straight, only twisting at its Extremities, to form the Volute.

7. Lastly, That of late Years, the Sculptors have added a little kind of Festoons, springing from the Flower whose Stalk lies on the Circumvolution of the Volute; and supposed to represent the Locks of Hair hanging down both Sides of the Face.

The *Ionic*, according to *Vitruvius*, is made thus: Divide the Semidiameter of the Body of the Column below into eighteen Parts, take nine such Parts, of which, three must go to the Cymatium, one to the Filler, and two to the Cima or Ogee under

it; then take four Parts for the Trochilus of the Volute or Scroll [the Trochilus is that Member from whence the Scroll begins] thence take four Parts from the Boultin, which is the fourth Part of a Circle, and which must be carved with Eggs and Anchors. Then take two Parts for the Astragal is carv'd with Eggs and Anchors; then take two Parts for the Astragal under the Boultin: The Astragal is carved with Beads, and has a Fillet on each Side of it, each one fourth of the Whole: Then the six Parts remaining must go to the half of the Volute below. Then take eight more such Parts, which must go to make the Remainder of the Frize or Neck of the *Capital*; and three more such Parts for the Astragal, under the Neck of which one Part goes to the Fillet.

Palladio's Description of this *Capital* agrees with that of *Vitruvius*; and *Scamozzi's* is so blind, that I believe scarce any are the wiser for it.

M. *Le Clerc* says, the most essential Part of this *Capital* is the Volute; which several Architects imagine to have been intended to represent the Rind or Bark of a Tree inclosed between the Abacus and Quarter-Round, having its two Extremes twisted into Scrolls, and those two Scrolls bound with a large Rope in the Middle; which comes pretty near the Figure that the Antients gave on the two Sides of the *Capital*.

Other Architects considering that this *Capital* bears some Resemblance to the Head-Dress of

a *Greek Lady*, believe it to have taken its Origin from thence: But this being a Matter of no great Use, we leave every one to judge of it as he pleases.

The *Capital* of the Antients being found improper in angular Columns, by reason of the Diversity of its Faces, *Scamozzi* compos'd a new one with four similar Faces.

Some Architects, however, won't allow the Volutes to spring out of the Vase of the *Capital*, but will have them consist of one and the same Rind continued under the Abacus; which, by this Means, will appear the better supported; an Instance of which we have in the Five Orders of M. *Perrault*. And they would have Reason on their Sides, were there the same good Taste in this, as in the other Design; but as that can't be, we must be contented with the other, which is easily design'd, and has a beautiful Appearance.

'Tis true, the new Abacus, which it has in his 49th Figure, being better proportion'd to the Largeness of the Volute than that of *Scamozzi*, renders it more graceful; besides, that it is further enrich'd with little festoons falling from the Volutes, which some modern Sculptors have been pleas'd to add.

He observes, that when there are Eggs cut in its Quarter-Round, their Number should be 24; and the Shaft or Fust should be channelled with an equal Number of Flutings.

He adds, we sometimes also cut Pearls and Olives in the Astragal, over the Ovolo, though
it

it belong to the Shaft ; But were the *Capital* made of a Matter different from that of the Shaft, then must the Altragal be considered as a Bauguette, making Part of the *Capital*, and not of the Shaft : To which last the Fillet underneath would be left ; were it otherwise, the *Capital* would be but poorly terminated by its Ovolo or Quarter-Round ; besides that, it would be too flat and squab.

He adds, that the Antients having made the Baluster of this *Capital* very short, there is some Difficulty in adjusting the Volutes to the Quarter-Round in the *Capitals* of the Pilasters.

This has occasioned several Architects to flatten or diminish the Convexity of the Quarter-Round ; which is a very considerable Irregularity, which they might have avoided, by lengthening out the Baluster, so as to go beyond the Quarter-Round ; at the same Time making the Circumvolution of the Volute advance a little further.

However, says he, if a Person has a mind to follow the Custom, he means, if he chuses to diminish the Convexity of the Quarter-Round, as is here done, he commits a Fault, that has good Authority on its Side : Which, however, he would do well to avoid, especially as it may be done without much Trouble.

A Difficulty of the same Kind may be met with in the Quarter-Round of the modern *Capital*, which our Architects have likewise diminished, in order to receive the Volutes more favourably, which should further have a Curvity, like that of the Aba-

cus ; but from which a man is under a Necessity of receding and of opening the Volutes, so as to be above the Quarter-Round, after it has run perpendicularly across the Face of the Pilaster : And the same, he says, may be understood of the *Roman Capital*.

The *Corinthian Capital* is much the richest ; it has no Ovolo, and its Abacus is very different from those of the *Tuscan*, *Doric*, or *Ionic* ; as having its Faces circular, hollowed inwards, with a Rose in the Middle of each Sweep.

Instead of Ovolo and Annulet, here is only a Brim of a Vase ; and the Neck is much lengthened and enrich'd with a double Row of each Leaves, bending their Heads downwards, and between them small Stalks arising, whence spring the Volutes, which do not resemble those of the *Ionic Capital* ; and which instead of the four in the *Ionic*, are here sixteen ; four on each Side under the four Horns of the Abacus, where the Volutes meet in a small Leaf, which turns back towards the Corner of the Abacus.

The Leaves are divided, each making three Ranges of lesser Leaves, of which they are composed ; each lesser Leaf is again most commonly parted into five, and are called Olive Leaves ; but sometimes into three, and are called Laurel Leaves : The middle Leaf, which bends down, is parted into eleven. In the Middle, over the Leaves, is a Flower shooting out between the Stems and Volutes, like the Rose in the Abacus.

The Height of this *Capital* is two Modules $\frac{1}{3}$, and its Projection $1\frac{1}{3}$.

The Differences in the Character of this *Capital* are, that in *Vitruvius*, &c. the Leaves are in the Form of the *Acanthus*; whereas in the Antique, they are more usually Olive Leaves.

2. That their Leaves are usually unequal, and the undermost commonly being made the tallest; but sometimes the shortest; tho' they are sometimes all equal.

3. Sometimes the Leaves are ruffled, sometimes quite plain: The first Row generally bellies out towards the Bottom; but at other Times they are straight.

4. Sometimes the Horns of the Abacus are sharp at the Corners, which seems to agree to the Rules of *Vitruvius*; but they are more usually cut off.

5. There is also some Difference in the Form and Size of the Rose.

6. The Volute are also sometimes joined to each other, and at other times wholly separate.

7. Sometimes the Spires of the Volute continue twisting, even to the End, in the same Course; and sometimes they are turned back again, near to the Centre, in the Form of an S.

According to *Vitruvius*, the Height of this *Capital* (by the Astragal at the Bottom) is equal to the Diameter of the Body of the Column below, one seventh Part of which goes to the Abacus; which consists of a Boulton, a Fillet, and a Plinth, [which is no other than a larger Fillet.]

The Abacus being subdivided into three parts, one of them

goes to the Boulton, and a third Part of the next goes to the Fillet, and the rest to the Plinth.

The Height of the Astragal below the *Capital*, is one twelfth Part of the Diameter of the Body below, and is divided into three Parts; of which the Fillet contains one, and the Boulton two.

Scamozzi makes this *Capital* in Height $1\frac{1}{6}$ of the Diameter of the Column; which being divided into 75 Parts, four of them go to the Boulton, one to the Fillet, nine to the Plinth, and the rest to the Neck.

Palladio makes this *Capital* equal in Height to the whole Diameter of the Body of the Column below; and one sixth Part more, which is allow'd to the Abacus, by which he is supposed to mean all the Mouldings above the *Acanthus* Leaves.

The Leaves of this *Capital*, *M. Le Clerc* says, are in Number 16, 8 in each Row.

Each Leaf, says *M. Le Clerc*, is divided into seven or nine Plumes; two of which, or to speak more properly, one whole and an half on each Side go to form the Return or Descent.

Sometimes the Return consists of three Plumes almost intire, each Plume being divided according to the Nature of the Leaf.

Upon this he remarks, that the Leaves of the *Capital* are ordinarily those of Olive, those of *Acanthus*, or those of *Smallage*; but he gives the Preference to the two last, and particularly when the *Corinthian* is raised over any other Order.

For its Leaves being flat and plain, they reflect more Light than the others, which are more wrought and uneven; for which Reason the first have a better Effect, when seen at a Distance, than the last; which are only fit to be viewed near at hand.

He likewise observes, that in making the Leaves either of this or the *Roman Capital*, great Care must be taken that they be well designed; particularly, that dividing them into Plumes, those Plumes don't run too far off from one another, but shall all together appear to form one single Leaf; which must not be too narrow towards the Top, that each Plume direct to its Origin, &c. Without such Precaution, the Leaves will lose all their Grace and Beauty.

If a *Corinthian* Order were to be placed very high, as in the Lanthorn of a Dome, he would rather chuse not to divide the Leaves of its *Capital* at all, but to preserve the Mass intire.

In some *Capitals* we find Leaves that are finely wrought, which nevertheless are of an extreme ill Taste, as those of Olives, for instance, in some Pilasters. This, he says, he mentions for the sake of those, who, having no great Share of Judgment, think they can't fail of doing well, if they do but imitate what they find in Buildings of Reputation.

The *Composite Capital* is so called, as partaking of the *Doric* in its Quarter-Round, of the *Ionic* in its Volutes, and of the *Corinthian* in its double Row of Leaves underneath, which are in Number 16.

M. *Le Clerc* says, the Leaves he gives it are of Laurel, which not being much edged or indented, are less delicate; and for that Reason more suitable to the Volutes of this Capital, which are tolerably massive, but agreeable to the Modillions of the Entablatures.

In the Middle of the Abacus, is a Flower, and under the Horns, Leaves which return upwards, as in the *Corinthian*: But instead of Stalks in the *Corinthian*, the *Composite* has small Flowers, which lie close to the Vase or Ball, twisting round towards the Middle of the Face of the *Capital*, and terminating in the Rose.

The Height of the *Composite Capital* is two Modules one Third, and its Projecture one Module two Thirds, as in the *Corinthian*.

1. The Differences of the Character of this *Capital* consist in this; that the Volutes which ordinarily descend and touch the Leaves, are in some Works of the Antique separated from them; that the Leaves which are generally unequal in Height, the lower Rank being the tallest, are sometimes equal.

2. That the Volutes of the Moderns generally spring out of the Vase; whereas they do in the Antique ordinarily run straight the Length of the Abacus, over the Ovolo, without striking into the Vase.

3. That the Volutes, whose Thickness is contracted in the Middle, and enlarg'd above and below in the Antique, in the Works

Works of the Moderns have their Sides parallel.

4. That the Volutes which have been hitherto made, as tho' solid, both by the Antients and Moderns, are now made much lighter, and more airy; the Folds standing hollow, and at a Distance the one from the other.

This *Capital*, called the *Composite* or *Roman*, is made and divided by *Vitruvius*, *Scamozzi*, and *Palladio*; except that the Carving of this is different from that.

Some Architects distinguish the *Tuscan* and *Doric Capitals*, which have no Ornaments, by the Title of *Capitals of Mouldings*; and the three other, which have Leaves and Ornaments, by the Title of *Capitals of Sculpture*.

An *Angular Capital*, is a *Capital* which bears the return of an Entablature, at the Corner of the Projecture of a Frontispiece.

Capital of a Balluster, is that Part which crowns the Balluster, which sometimes does somewhat resemble the *Capitals* of some Columns, and particularly the *Ionic*.

M. Le Clerc gives the *Capital* of the *Spanish Order* eight large Leaves, simple, but a little wav'd with grenate Stalks, or Flowers rising among them, which may be managed in various Manners, according to the various Places where this Order is used.

The Horns of the Abacus are supported by little Volutes; the Middle of the Abacus being adorned with a Lion's Snout instead of a Rose, which noble Animal is the Symbol of *Spain*, and expresses the Strength and

Gravity, as well as the Prudence of that Nation.

In the Friezes over this *Capital* may be added a terrestrial Globe; with Cornucopia's, Palms and Laurels, which are significant Ornaments that explain themselves.

Capital of a Triglyph, is the Plat-band over the Triglyph; which *Vitruvius* calls *Tenia*. Also a Triglyph sometimes does the Office of a *Capital* to the *Doric Pilaster*.

Capital of a Nich, is a sort of little Canopy made over a shallow Nich, which covers or crowns a Statue.

CAR } A kind of rolling
CARR } Throne used in Tri-
CARRE } umphs for Victories,
in which the General; sits and in the splendid Entries of Princes.

CARACOL, a Term sometimes used in Architecture for a Stair-Case, in a helix or spiral Form.

CARCASE, is the Shell or Ribs of a House, containing the Partitions, Floors, and Rafters made by the Carpenter; or it is the Timber Work (or, as it were, the Skeleton) of a House, before it is lathed and plastered. It is otherwise called *the Framing*.

The Price of Framing. Some Workmen say, that the Price of *Framing* the *Carcase* of a House, (in the Country) is about eight Shillings *per Square*, if the Workman pay for the sawing of the Timber; and if he does not, about four Shillings and Sixpence *per Square*.

CARIATIDES or CARIATES. See CARYATIDES.

CARINA,

C A

CARINA, a Term used in antient Architecture, a Name given by the Romans to all Buildings in the Form of a Ship, [from *Carina*, the Keel of a Ship,] as we still use the Word *Nave* for *Navis*, a Ship, the middle or principal Vault of our Churches, because it has that Figure.

CARPENTERS *Work*, in a Building, includes the Framing, Flooring, Roofing; the Foundation, Carcase, Doors, Windows, &c.

Of *Carpenters Work*: The several kinds of it, (in relation to Building) with their Prices and Methods of measuring them, &c. are too many to be comprehended under this so general a Term as *Carpenters Work*; for which Reason they shall be referred to their Particulars, (as Framing, Flooring, Roofing, &c.)

See the Work both by Decimals, and also by Feet and Inches.

57	25
28	5
2862	5
5800	
11450	
1631.62	5

Facit 16 Squares, and 31 Feet.

Note, That 5 is the Decimal for Half of any Thing, 25 is the Decimal for a Quarter, or 3 Inches; and 125 is the Decimal of 1 Inch and half, or $\frac{1}{2}$; be-

C A

The Measuring of Carpenters Work.

Carpenters Works, which are measurable, are Flooring Partitioning, or Roofing; all which are measured by the Square of ten Feet long, and ten broad; so that one Square contains 100 square Feet.

1. Of Flooring.

If a Floor be 57 Feet 3 Inches long, and 28 Feet 3 Inches broad, how many Squares of Flooring is there in that Room?

Multiply 57 Feet 3 Inches by 28 Feet 6 Inches, and the Product is 1631 Feet, &c. which divide by 100, (this is done by cutting off two Figures towards the Right Hand with a Dash of the Pen,) and the remaining Figures are the Quotient, and the Figures cut off are Feet: Thus 1631 divided by 100, by cutting off 31 from the Right Hand thereof, the Quotient is 16 Squares, and the 31 cut off is 31 Feet.

F.	I.
57	3
28	6
456	
114	
28	7 6
7	0 0
1631	7 6

cause 3 Inches is a quarter of a Foot, and 5 is the Decimal of 6 Inches; because 6 Inches is half a Foot.

Example

C A

Example 2. Let a Floor be 53 Feet 6 Inches long, and 47 Feet 9 Inches broad; how ma-

$$\begin{array}{r}
 47.75 \\
 53.5 \\
 \hline
 23875 \\
 14325 \\
 13875 \\
 \hline
 25|54.625 \\
 \hline
 \end{array}$$

C A

ny Squares are contained in that Floor?

$$\begin{array}{r}
 F. \quad I. \\
 53 \quad 6 \\
 47 \quad 9 \\
 \hline
 371 \\
 212 \\
 \hline
 26 \quad 9 \\
 13 \quad 4 \quad 6 \\
 23 \quad 6 \\
 \hline
 25|54 \quad 7 \quad 6 \\
 \hline
 \end{array}$$

Facit 25 Squares, and 54 Feet.

By Scale and Compasses.

In the first Example, extend your Compasses from 1 to 28.5; and that Extent will reach from 57.25 to 16 Squares, and near a third Part.

In the second Example, extend the Compasses from 1 to 47.75, and that Extent will reach from 53.5 to 25 Squares, and above a half.

$$\begin{array}{r}
 12.25 \\
 82.5 \\
 \hline
 6125 \\
 2450 \\
 9800 \\
 \hline
 10|10.625 \\
 \hline
 \end{array}$$

Of Partitioning.

Example 1. If a Partition between Rooms be in Length 82 Feet 6 Inches, and in Height 12 Feet 3 Inches; how many Squares are contained therein?

The Length and Breadth being multiplied together, the Product will be 1010.625; which divide by 100, (as before has been shewn,) and the Answer is 10 Squares 10 Feet; the Inches or Parts in these Cases.

$$\begin{array}{r}
 F. \quad I. \\
 82 \quad 6 \\
 12 \quad 3 \\
 \hline
 990 \quad 0 \\
 20 \quad 7 \quad 6 \\
 \hline
 10|10 \quad 7 \quad 6 \\
 \hline
 \end{array}$$

Facit 10 Squares 10 Feet.

C A

If a Partition between Rooms be in Length 19 Feet 9 Inches, and in Breadth 11 Feet 3 Inches; how many Squares are contain'd therein ?

$$\begin{array}{r}
 61.75 \\
 11.25 \\
 \hline
 45875 \\
 18350 \\
 2175 \\
 9175 \\
 \hline
 \end{array}$$

Of Roofing.

It is a Rule among Workmen, that the Flat of any House, and half the Flat thereof, taken within the Walls, is equal to the Measure of the Roof of the same House; but this is when the Roof is true pitch'd; for if the Roof be more flat or steep than the true Pitch, it will Measure to more or less accordingly

Example 1. If a House with-

$$\begin{array}{r}
 18.25 \\
 44.5 \\
 \hline
 9125 \\
 7300 \\
 7300 \\
 \hline
 \text{Flat } 812.125 \\
 \text{Half } 406 \\
 \hline
 12|18
 \end{array}$$

By Scale and Compasses.

In the first Example of Partitioning, extend the Compasses from 1, to 12. 25, and that Ex-

C A

The Length and Breadth being multiplied together, the Product is 1032 Feet; which divided by 100, the Answer will be 10 Squares and 32 Feet.

$$\begin{array}{r}
 F. \quad I. \\
 91 \quad 9 \\
 11 \quad 3 \\
 \hline
 1009 \quad 3 \\
 22 \quad 11 \quad 3 \\
 \hline
 10|32 \quad 2 \quad 3
 \end{array}$$

in the Walls be 44 Feet 6 Inches long, and 18 Feet 3 Inches broad; how many square Feet of Roofing will cover that House?

Multiply the Length and Breadth together, and the Product will be 812 Feet the Flat; the Half of which is 406, which being added to the Flat, the Sum is 1218; which being divided by 100, the Answer is 12 Squares, and 18 Feet.

$$\begin{array}{r}
 F. \quad I. \\
 44 \quad 6 \\
 18 \quad 3 \\
 \hline
 352 \\
 11 \quad 1 \quad 6 \\
 9 \quad 0 \quad 0 \\
 \hline
 \text{The Flat } 812 \quad 1 \quad 6 \\
 406 \\
 \hline
 \text{Sum } 12|18
 \end{array}$$

Facit 12 Squares, 18 Feet.

tent will reach from 82. 5. to ten Squares and one Tenth.

In the second Example, extend the Compasses from 1 to 11.25, and that Extent will reach from 91.75 to ten Squares, and a little less than a third Part.

In the Example of Roofing, extend the Compasses from 18.25, that Extent will reach from 44 5 to 812, the Flat; to which add the half thereof, and the Sum is 12.18, which is 12 Squares 18 Feet, as above.

There are other Works about a Building done by the *Carpenter*, that are measured by the Foot, running Measure; that is, by the Number of Feet in Length only, as Cornices, Doors and Cases, Window-Frames, Gutterings, Lintels, Summers, Skirt-Boards, &c.

Note 1. In the measuring of Flooring, after the whole Floor has been measured, there are to be deducted out of it the Well-Holes for the Stairs and Chimneys; and in Partitioning, for the Doors, Windows, &c. except (by Agreement) they are to be included.

Note 2. In measuring of Roofing, seldom any Deductions are made for the Holes for the Chimney-Shafts, the Vacancies for Lanthorn-lights and Sky-lights; for they are more Trouble to the Workman, than the Stuff that would cover them is worth.

CARPENTRY [*of Carpentum, L. a Car or Cart*] is the Art of cutting, framing, and

joining large Pieces of Wood for the Uses of Building; it is one of the Arts which is subservient to Architecture, and is divided into 2 Branches, *viz.* House Carpentry and Ship Carpentry. The first is employ'd in raising, roofing, flooring, &c. of Houses, &c. And the second, in the Construction or Building of Vessels for the Sea, as Ships, Barges, &c.

The Rules and Practices in Carpentry, are much the same with those of Joinery, as to sawing, planing, mortising, tennanting, moulding, scribing, paring; and so also are the Tools or Instruments used by them, and likewise the Stuff or Materials. All the Difference between the two Arts consists in this, that Carpentry is used in the larger, stronger, and coarser Work; and Joinery in the smaller and more curious.

Fr. Pyrard says, that the Art of Carpentry is in its greatest Perfection in the *Maldives Islands*: He observes that their Works there are so artfully managed, that they will hold tight and firm without either Nails or Pins; and that they are so ingeniously and curiously put together, that no Person can take them to pieces, but one who is acquainted with the Mystery.

To make a Carpenter's Bill: This is to be done after the following Manner.

Mr. *Thomas Johnson*, of *London*, his Bill of Materials had of, and Work done by *John Robinson*, this 23d of *June 1733*.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
For 15 Loads of Oaken Timber, at 21 <i>s.</i> the Load	15	15	00
For 24 Loads of Fir Timber, at 33 <i>s.</i> the Load	42	12	00
For 150 Feet of Oaken Planks, two Inches thick, } at 3 <i>d.</i> per Foot	01	17	06
For 15 M. 10 <i>d.</i> Nails, at 6 <i>s.</i> per M.	04	10	00
For 6 C. of Deals, at 6 <i>l.</i> the C.	36	00	00
For 30 lb. of large Spikes, at 4 <i>d.</i> per lb.	00	10	00
For 7 Weeks Work for myself at 3 <i>s.</i> per Day	06	06	00
For 7 Weeks Work for my Man, at 2 <i>s.</i> 6 <i>d.</i> per Day	05	10	00
The Total is	113	00	06

But here it is to be noted, if the *Carpenter* does not work by the Day, then he writes or makes his Bill for so many Square of Roofing (at the Price agreed upon per Square) so much Money.

Likewise, for so many Square of Flooring, at so much per Square, so much Money.

Also, for so many Squares of Partitioning, at so much per Square, so much Money.

Also, for so many Square of Cieling Joists, &c.

Windows are either set down at so much per Light, or so much per Window.

The Door Cases at so much per Piece, either inward or outward.

Mantletrees, Tassels, &c. at so much per Piece.

The Lintelling, Guttering, Cornice, Winder-Boards, &c. at so much per Foot.

Stairs, either at so much per Pair, or so much per Step, &c.

CARTON, } a Design in
CARTOON, } Painting, made
on strong Paper, to be afterwards calked through, and transferred on the fresh Plaster of a Wall, to be painted in Fresco.

CARTOUCHES, } [of Car-
CARTOUSES, } toccio, I-
CARTOUZES, } talian]
an Ornament in Architecture, Sculpture, &c. representing a Scroll of Paper. It is usually a Table, or flat Member with Wavings, on which is some Inscription, or Device, Ornament of Armoury. Cypher, or the like. They are sometimes made of Stone, Brick, Plaster, Wood, &c. for Buildings.

The

They are, in Architecture, often much the same as Modillions; only these are set under the Cornice, in Wainscoting, and those under the Cornice, at the Eaves of a House.

Perrault says, *Cartouch* is an Ornament of carved Work, of no determinate Form, whose Use is to receive a Motto or Inscription.

CARTRIDGES, in Architecture, as some Workmen call them, are the same as Cartouches.

CARYATIDES, } [so called
CARIATES, } from the
Caryatides a People of *Caria*] are in Architecture, a kind of Order of Columns or Pilasters, under the Figures of Women dress'd in long Robes, after the Manner of the *Carian* People, and serving instead of Columns to support the Entablement.

Vitruvius relates the Origin of the *Caryatides*. He observes, that the *Greeks* having taken the City of *Caria*, led away their Women Captives; and to perpetuate their Servitude, represented them in their Buildings as charged with Burdens, such as those supported with Columns.

M. Le Clerc, aptly enough, calls these, Symbolical Columns and tells us, that the ancient *Greeks* had a Custom in the Columns of their publick Buildings, to add Figures and Representations of the Enemies they had subdued, to preserve the Memory of their Victories.

That they having reduced the rebellious *Carians* to Obedience, and led away their Wives Cap-

tives; and that the *Lacedemonians* having vanquish'd the *Persians* at *Plataea*, they were the first Subjects of these Columns; which have preserved to late Posterity both the Glory of the Conquerors, and the Dishonour of the Conquered.

And hence originally came the Names *Caryatides*, and *Persian* Columns; which Names have been since apply'd to all Columns made in human Figures, though with Characters very different from one another.

M. Le Clerc likewise observes, that the *Caryatides* are not now represented among us, as they were among the Antients, viz. as Subjects of Servitude and Slavery, viz. with Hands tied before and behind, such Characters seeming injurious to the fair Sex; and for that Reason we give them others entirely opposite, never using them in building but as singular Beauties, and such as make the greatest Ornament thereof.

Among us, they are represented under the noble Symbols, or Images of *Justice*, *Prudence*, *Temperance*, &c.

The *Caryates* should always have their Legs pretty close to each other, and even across, or the one athwart the other, their Arms laid flat to their Bodies, or to the Head, or as little spread as possible; that as they do the Office of Columns, they may as near as possible bear the Figures of them.

When the *Caryatides* are insolated, they should never have any great Weight to support; nor greater than those of Balconies,

nies, little Galleries, or slight Crownings, and their Entablature and Pedestal are not to be thought so proper to bear great Loads.

If the *Caryatides* have a Proje&ture beyond the Wall, in the Manner of Pilasters, they may be used in the Architecture of a Gallery or Salon, provided they may be not made to sustain any Thing but an Entablature, the Weight of the Vault being born by the Wall behind, which serves them as a Ground or Bottom.

The *Caryatides* ought always to appear in Characters proper to the Places they are used in. As for Instance, those which support the Crowning of a Throne, should be Symbols or Representations of Heroick Vertues.

Those which are set in a Place of Devotion, should bear the Characters of Religion, and those in Halls, and Banqueting-Rooms, should carry the Marks of Mirth and Rejoicing.

Caryatides, and common Columns, should never be used together under the same Entablature; for besides that, there can never be a just Symmetry between them. The Figures of Women, as tall as common Columns, would appear monstrous, and make all the rest of the Architecture appear low and mean.

Again, the *Caryatides* should never be made of an immoderate Stature, lest being too large, they might become frightful to Ladies; and for this Reason, one would chuse to confine them sometimes under the Impost of a Portico, such Imposts serving them for an Entablature.

VOL. I.

They may also upon Occasion be raised upon Pedestals, which ought not to be lower than one Third of their Height: And besides this, if there be Consoles placed over their Heads, the Figures may be made of a reasonable Height.

Sometimes the Arms of the *Caryatides* are cut off for the greater Delicacy, as those for Instance, in the Halls of the *Swiss* Guards in the *Lowvre*. But M. *Le Clerc* does not approve of such Mutilations.

These Kinds of Mutilations, which are only used to make the Figures more light and delicate, or rather to make them more conformable to the Columns, are only proper for *Termi*, or Forms, which are a kind of Half-human Figures, seeming to proceed out of a Vagina or Sheath.

The *Caryatides* are sometimes represented in the Form of Angels; which, M. *Le Clerc* is of Opinion; should not be, except at Baldaguins, and Altars. And such as do appear under that holy Form, ought, in his Opinion, to support the Entablature with their Hands; or as others say, with their Heads, as bearing it easily and without Trouble.

The Entablature supported by Angels, M. *Le Clerc* would have to be of the *Corinthian* Order; and that by the Vertues, of the *Ionic*; and both the one and the other somewhat less massive than the ordinary.

The Antients made the *Caryatides* frequently to support Corbels or Baskets of Flowers; and

O

these

these they called Caniferæ, and Cistiferæ.

CASCADE, is a Cataract or Water-Fall; either natural as that at *Tivoli*, &c. or artificial, as those of *Versailles*, and that either falling with a gentle Descent, as those of *Sceaux*; in Form of a Buffette, as at *Trignon*; or by Degrees, in Form of a Per-ron, as at *St. Cloud*; or from Basen to Basen, &c.

CASING of *Timber-Work*, is the Plaistering a House all over on the Outside with Mortar, and then striking it wet by a Ruler, with the Corner of a Trowel, or the like Instrument, to make it resemble the Joints of Freestone; by which Means, the whole House appears as if built thereof.

As to the Method of doing it: Some direct it to be done upon Heart Laths; because that the Mortar would in a little Time decay Sap-Laths: And although it will require more Labour to lath it with Heart, than with Sap Laths, yet will be better for the Mortar to hang to, because Heart-Laths are the narrowest; and Laths ought to be closer together for Mortar, than for Loam. They also say, that they commonly lay it on in two Thicknesses, viz. a second before the first is dry.

As to the Price: It has been done for 3 *d.* or 4 *d.* per Yard, including Doors and Windows, i. e. measuring it as if there were none, and for 6 *d.* per Yard excluding Doors and Windows, i. e. deducting them from the Whole.

CASE of *Glass*, as of Crown Glass.

A *Cafe* of Crown Glass contains usually twenty-four Tables; each Table being circular, or nearly so, and about three Feet six Inches, or three Foot eight Inches Diameter.

Newcastle Glass: A *Cafe* contains thirty-five Tables, and each Table does, or ought to contain six Feet of Glass. Some that have been measured, contained three Feet and a half on the upper or circular End, and about eighteen or twenty Inches at the lower End. and the Perpendicular Height about three Feet.

Mr. *Leybourn*, and from him, Mr. *Wing*, says, that a Table of *Newcastle Glass* contains about five Feet; and that forty-five of those Tables go to a *Cafe*.

Mr. *Wing* also says, that twenty-five Tables make a *Cafe* of *Normandy Glass*.

CASEMATE, 2 in Building, CASEMENT, 5 is a hollow Moulding, which some Architects make one Sixth of a Circle; and others, one Fourth.

CASEMENTS, in Architecture, are Windows to open.

As to the Price: Mr. *Leybourn* says, they are valued according to their Largeness and the Goodness of their Workmanship in their Locks and Hinges, from 3 *s.* to 20 *s.* a *Casement*.

Casements about two Feet and a half long, are worth about 4 *s.* or 4 *s.* 6 *d.* apiece.

Folding Casements, of the like Size, with Bolts, Hinges, &c. about 12, or 13 *s.* the Pair.

Mr. *Wing* says, they are worth 7 *d.* or 8 *d.* the Pound, and some of them 9 *d.*

Some Smiths in *London* have asked 6 *d.* a Pound for *Casements*,

ments, and said they were worth more if they had Turnbouts (or Turn-buckles, as some called them,) or Cock-spurs, and Pull-backs at the hind Side, to pull to with.

Some Smiths in the Country make them by the Foot, measuring the whole Circumference round by the outer Edge of the *Casement*; so if a *Casement* be two Feet long, and $\frac{1}{2}$ broad, they reckon it to make seven Feet.

In *Suffex*, they have been offer'd to be made for 6*d.* per Foot, if ordinary; but if something extraordinary (as *Folding Casements*, &c.) 8*d.* a Foot.

Of Painting them: They are usually painted at three Half-pence, two Pence, or three Pence apiece, according as they are in Largeness.

Of Hanging *Casements*: Country Glaziers say, Hanging of *Casements* is Smiths Work, and that if they don't do it, they pay the Glaziers for doing it, at the Rate of two Pence for hanging a small *Casement*, and three Pence apiece for large ones.

CASTING, with Founders, is the Running of a melted Metal into a Mould prepared for that Purpose.

Casting of Lead on Cloth, is the Using a Frame or Mould cover'd with Woollen Cloth, and Linnen over it, to cast the Lead into very fine Sheets.

Casting in Sand or Earth, is the Running of a Metal between two Frames or Moulds filled with Sand or Earth, wherein the Figure the Metal is to take, has been impress'd *in creux* by Means of a Pattern.

Casting in Stone or Plaster, is the filling a Mould with fine liquid Plaster, that had been taken in Pieces from off a Statue, or other Piece of Sculpture, and run together again.

There are two Things to be minded in respect to the Mould.

First, That it be well soak'd in Oil, before the Plaster be run, to prevent its Sticking.

Secondly, That each Piece of which it consists, have a Pack-thread to draw it off the more easily when the Work is dry.

Casting in Joinery, &c. Wood is said to cast or warp, when either by its own Drought, or Moisture of the Air, or other Accidents, it shoots or shrinks, and alters its Flatness and Straightness and becomes crooked.

CATACOMBS, Grotto's, or subterraneous Places for the Burial of the Dead.

CATADROME, a kind of Engine like a Crane, used by Builders in lifting up and letting down any great Weights.

CATAFALCO [in *Italian*, a Scaffold] in Architecture, it is used for a Decoration of Architecture, Sculpture, or Painting, raised on a Timber-Scaffold, to shew a Coffin or Tomb in a Funeral Solemnity.

CATENARIA [in the Higher Geometry] a Curve Line, which a Chain or Rope forms itself into, when hung freely between two Points in Suspension.

CATHETA, a Perpendicular or Plumb Line falling from the Extremitie of the Underside of the Cymatium (of the *Ionic Capital*) through the Centre of the Volute.

CATHETUS, in Geometry, a Perpendicular, or a Line, or Radius, falling perpendicularly on another Line or Surface.

Cathetus of Incidence, in Catoptricks, is a right Line drawn from a radiant Point perpendicular to the Plane of the Speculum or Mirrour.

Cathetus of Reflexion, or of the Eye, is a Right Line drawn from any Point of a reflected Ray, perpendicular to the Plane of Reflexion, or of the Speculum.

Cathetus of Obliquation, is a Right Line drawn perpendicular to the Speculum in the Point of Incidence or Reflexion.

Cathetus, in Architecture, is a perpendicular passing along through the Middle of a Column. See **CATHETA**.

CATOPTRICKS [of *κατοπτρον*, Gr. a Speculum] the Science of Reflex Vision, or that Branch of Opticks, which treats of, or gives the Laws of Light reflected from Mirrours or Specula.

CAVETTO [the Word is *Italian*, and signifies the same as hollow] a hollow Member, or round concave Moulding containing a Quadrant of a Circle, and having a quite contrary Effect to that of a Quarter-Round, it is used as an Ornament in Cornices.

Mr. *Felibien* takes Notice, that Workmen confound the *Cavetto* with a Scotia, but to ill Purpose, the *Cavetto* being indeed only half a Scotia.

When it is in its natural Situation, it is by Workmen frequently called Gula, or Guele, or Mouth, in *English*; and when inverted, Gorge or Throat.

CAVASION, in Architecture, a Term used to signify the Under-digging or Hollowing of the Earth for the Foundation of a Building. This, *Palladio* says, ought to be the sixth Part of the Height of the whole Building.

CAULICOLES, ² are 8 lesser **CAULICOLI**, ³ Branches or Stalks in the *Corinthian* Capital, springing out from the four greater or principal Caules or Stalks.

The eight Volutes of this Order are sustained by four Caules or primary Branches of Leaves, and from which these Caulicoles or lesser Foliages do arise.

Some Authors confound these with the Volutes themselves; some with the Helices in the Middle; and some with the principal Stalks whence they arise.

Some define them to be carved Scrolls (under the Abacus) in the *Corinthian* Capital.

CEILING, the upper Part or Roof of a lower Room, or a Lay or Covering of Plaister over Laths nail'd on the Bottom of the Joists, which bear the Floor of the upper Room, or on Joists put up for that Purpose, and called Ceiling-Joists, if it be in a Garret.

These Plaister'd Ceilings are much used in *England*, more than in any other Country, nor are they without their Advantages, they making the Rooms lightsome, are excellent in Case of Fire, stop the Passage of the Dust, and lessen the Noise over Head, and in the Summer-Time, make the Air of the Rooms cooler.

Of Measuring *Ceilings*: This Sort of Work is usually done by the Yard (containing nine superficial Feet,) and in taking the Dimensions, if the Room be wainscotted, they consider how far the Cornice bears into the Room, by putting a Stick perpendicular to the *Ceiling*, close to the Edge of the uppermost Part of the Cornice, and measuring the Distance from the perpendicular Stock to the Wainscot; twice which Distance is deducted from the Length and Breadth of the Room taken upon the Floor, and the Remainder gives the true Length and Breadth of the *Ceiling*; which if it be taken in Feet, as it most usually is, the one being multiply'd into the other, and the Product divided by 9, gives the Content in Yards square.

As to the Price: The Workmanship, *viz.* Lathing, Plaistering, and Finishing, is commonly reckon'd at *London*, at about two Pence three Farthings per Yard.

In some Places of the Country, as *Kent*, &c. they have three Pence a Yard. And in some Parts of *Suffex*, some Workmen say they have four Pence for Workmanship only.

But if the Plaisterer finds all Materials, and lath it with Laths of Heart of Oak, they usually reckon 1 s. a Yard, and if Fir-Laths, about 8 d

CEILING-*Joists* or Beams.

Of measuring them: The Workmanship of putting up *Ceiling-Joists*, is measured by the Square; so that the Length in Feet being multiplied by the Breadth in Feet, and two Places

of Figures being cut off on the Right Hand, what remains on the Left Hand, is Squares; and what is cut off is odd Feet, 25 of which make a Quarter; 50, a half; 75, three quarters of a Square.

As for the Price: The putting up *Ceiling-Joists* is valued at 4, 5, or, some say, 6 s. a Square.

CELERITY [in Mechanicks] is the Velocity or Swiftnes of a moving Body, or that Affection of a Body in Motion, by which it is enabled to pass over a certain Space in a certain Time.

CELLS, are little Houses, Apartments, or Chambers; particularly those wherein the Ancient Monks and Hermits, &c. liv'd in Retirement.

CELLARS, are the lowest Rooms in a House; the Ceilings of which lie level with the Surface of the Ground on which the House stands, or at most, but very little higher.

As to their Situation: Sir *Henry Wotton* says, they ought, unless the whole House be cellared, to be situated on the North Side of the House, as standing in Need of a cool and fresh Air.

Of Digging them: They are usually dug by the Solid Yard, which contains twenty-seven solid Feet; and therefore the Length, Breadth, and Depth being all multiply'd together, and the Product divided by 27, the Quotient will give the Content in solid Yards.

CEMENT, } in the general
CEMENT, } of the Word,
CIMENT, } signifies any
Composition of glutinous, or
O 3 tenacious

tenacious Nature, proper for binding, uniting, and keeping Things in Cohesion.

Cement, in Architecture, is a strong Sort of Mortar, used to bind or fix Bricks or Stones together for some kind of Mouldings; or in cementing a Block of Bricks (as they call it;) for the carving of Capitals, Scrolls, or the like.

It is of two Sorts; one called *Hot Cement*, and the other *Cold Cement*; because the *Hot Cement* is made and used with Fire; and the *Cold Cement* is made and used without Fire.

To make the *Hot Cement*, take half a Pound of Bees-Wax, an Ounce of fine Brick-Dust, an Ounce of Chalk-Dust or powdered Chalk; sift both the Brick-Dust and Chalk through a fine Hair-Sieve, (the Brick and Chalk may be beat in a Mortar, before it is sifted.) Let all these be boiled together in a Pipkin, or other Earthen Vessel, for about a quarter of an Hour, keeping it continually stirring with a Piece of Iron or Lath, then take it off, and let it stand for four or five Minutes, and it is fit for Use.

The Bricks which are to be cemented with this Kind of *Cement*, must be made hot by the Fire, before the *Cement* is spread on them; and after that, be rubbed to and fro one upon another, after the same Manner that Joiners do, when they glue two Boards together.

The *Cold Cement* is less used; and is accounted a Secret known but to few Bricklayers.

It is made after the following Manner;

Take a Pound of old *Cheeshire* Cheese, pare of the Rind, and throw it by, then cut or grate the Cheese very small, put it into a Pot with a Quart of Cows Milk; let it stand all Night, and in the Morning, take the Whites of twenty-four or thirty Eggs, and a Pound of the best unslack'd or quick Lime, and beat it in a Mortar to a very fine Powder, sift it in a fine Hair-Sieve, put the Cheese and Milk to it in a Pan, or Bowl, and stir them well together with a Trowel or such like Thing, breaking the Knobs of the Cheese, if there be any, then add the Whites of Eggs, and temper all well together, and it will be fit for Use.

This *Cement* will be of a white Colour; but if you will have it of the Colour of Brick, put into it, either some very fine Brick-dust, or some Almegram, but not too much, but just enough to give it a Colour.

CENTRE, [in Geometry] of a Circle, is a Point in the Middle of a Circle, or circular Figure, from which all Lines drawn to the Circumference, are equal.

Centre of a Parallelogram or Polygon, is the Point wherein its Diagonals intersect.

Centre of Magnitude is a Point equally remote from the extrem Parts of a Line, Figure, or Body; or the Middle of a Line or Plane, by which a Figure or Body is divided into two equal Parts.

Centre of a Sphere is the Point from which all the Lines drawn to the Surface, are equal.

Centre of an Ellipsis is that Point where the two Diameters, the Transverse, and the Conjugate, intersect each other.

Centre of Gravity, in Mechanics, is a Point within a Body, through which, if a Plane pass, the Segments on each Side will equiponderate, i. e. neither of them can move the other.

CENTRAL, something relating to a Centre.

CHALK, a white Substance usually accounted as a Stone: Though Dr. *Stare* thinks there is not sufficient Reason for it; since it having been examin'd by the Hydrostatical Balance, it is found to want much of the Weight and Consistence of a real Stone.

Chalk is of two Sorts, the hard dry strong Stone, used in making Lime; the other is a soft unctuous Chalk, used for manuring Lands; easily dissolving with Rain and Frost.

CHAMBER, in a House, or Building, is any Room situate between the lowermost (excepting Cellars,) and the uppermost Rooms. So that there are in some Houses two, in others three or more Stories of Chambers.

Sir *Henry Wotton* directs, that the principal Chambers for Delight be situated towards the East.

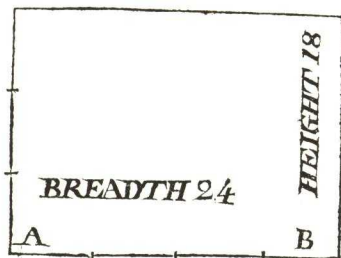
As to the Proportions: The Length of a well-proportion'd Lodging should be the Breadth and half of the same, or some small Matter less; but should ne-

ver exceed that Length. As for the Height, three Fourths of the Breadth will be a fit Height.

Palladio directs that Chambers, Antichambers, and Halls, either flat, or arched, be made of the following Heights.

If they be flat, he advises to divide the Breadth into three Parts, and to take two of them for the Height of the Story from the Floor to the Joist, as in the Figure.

Let the Figure represent the Chamber, whose Height you would find, which suppose to have in Breadth 24 Feet within the Work, which shall be divided upon the Line AB into three equal Parts within Points, where



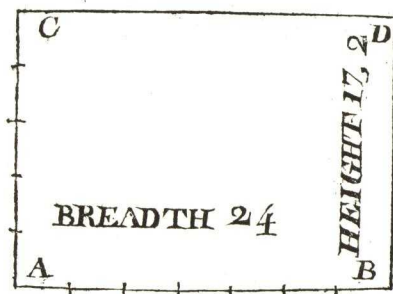
is mark'd the Numbers 1, 2, 3, each Part being eight Feet; two of each Parts shall be the Height of the Chamber, &c. to wit, sixteen Feet from the Floor to the Joist.

If you would have it higher, the Breadth must be divided into seven Parts, of which take five for the Height.

C H

C H

Let the Figure be of the same wit, twenty-four Feet within Breadth with the foregoing, to the Work, which shall be divided

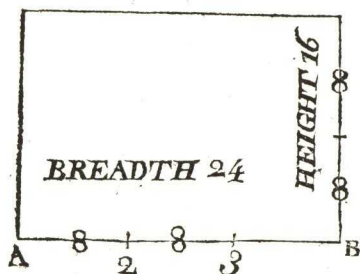


upon the Line AB into seven equal Parts; take five of them to make the Height of the Story AC and BD, and the said Height will be seventeen Feet

two Inches from the Floor unto the Joists.

Or divide the said Height into four Parts; and three of those Parts will likewise give a greater Height.

Let the Figure be of the same Breadth, viz. twenty-four Feet within the Work; which divide upon the Line AB into four e-



bers below; as suppose its first Story be sixteen Feet from the Floor to the Joist, divide the sixteen Feet into twelve equal Parts; and take eleven of them, which will make fourteen Feet eight Inches for the Height of the second Floor to the Joist.

Again, suppose the first Story be seventeen Feet two Inches, and in twelve equal Parts; take eleven of them which will make fifteen Feet, seven Inches for the Height of the second Story from the Floor to the Joist.

equal Parts; three of which you must take for the Height of the Story, which will be eighteen Feet from the Floor to the Joist,

The Height of the Chambers of the second Story shall be a twelfth Part less than the Cham-

If you would make above the Second Story and Attic, or third Story, the second must always be divided into twelve equal Parts; nine of which will give the Height from the Floor to the Bottom of the Joists.

In the building of *Chambers*, Regard ought to be had as well to the Place of the Bed, which is usually six or seven Feet square; and the Passage, as well to the Situation of the Chimney; which, for this Consideration, ought not to be placed just in the Middle, but distant from it about two Feet, or two and a half, to the End it may make Room for the Bed; and by this Means the Inequality is little discern'd, if it be not in Buildings of the Breadth at least of 24 Feet within the Work; and in this Case, it may be placed just in the Middle.

CHANCEL [so called, of *Cancellæ*, Lettices or cross Bars, wherewith the *Chancels* were anciently encompassed, as they are now with Rails] a Part of the Choir of a Church, between the Altar, and the Communion-Table, and the Balustrade or Rails that inclose it; where the Minister stands at the Celebration of the Holy Communion.

CHANNEL in Architecture, is particularly used for a Part of the *Ionic* Capital, a little hollow'd, in Form of a Canal, lying under the Abacus, and running the whole Length of the Volute, inclosed by a Listel; or it is otherwise described to be that Part of the *Ionic* Capital, which is under the Abacus, and lies open upon the Echinus or Eggs, which has its Centres or Turnings on every Side, to make the Volutes.

Channel of the Larmier is the Soffit of a Cornice which makes the Pendant Mouchette.

Channel of the Volute, in the *Ionic* Capital, is the Face of its

Circumvolution, inclosed by a Listel.

CHANTLATE, in Building, a Piece of Wood fastened near the Ends of the Rafters, and projecting beyond the Wall to support two or three Rows of Tiles, so Placed, to hinder the Rain Water from trickling down the Sides of the Walls.

CHAPEL } A sort of little
CHAPPEL } Church, where an Incumbent, under the Denomination of a Chaplain, officiates.

CHAPLET, a String of Beads, called *Pater-nosters*, used in the *Romish* Church.

CHAPLET, in Architecture, is a small Ornament cut or carved into round Beads, Pearls, Olives, and *Pater-nosters*, as is frequently done in *Baguettes*.

A *Chaplet* is, in truth, little else but a *Baguette*, enriched with Carving.

CHARGE, in Painting. *Over-Charge* is an exaggerated Representation of any Person, wherein the Likeness is preserved, but ridiculed.

The Method is to push out and heighten something already amiss in the Face, whether by way of Defect or Redundancy: Thus, *v. gr.* if Nature has given a Man a Nose a little larger than ordinary, the Painter falls in with her, and makes the Nose extravagantly long; or if the Nose be naturally too short, in the Painting, it shall be made a mere Stump; and so of the rest.

CHARNEL, a Building, a kind of a Portico or Gallery, usually in or near the Church-Yard, over which were antiently

ly laid the Bones of the Dead, after the Flesh was totally consumed.

CHESNUT. The *Horse-Chesnut*, says a certain Author, ought to be universally propagated, being easily increased from Layers, and grows in goodly Standards, and bears a most glorious Flower: It is much used for Avenues in *France*, and was brought into these Parts of *Europe* from *Turkey*, and has been raised from Nuts brought from thence; which grow well with us, and in Time to fair large Trees, full of Boughs and Branches, green-leaved, and streaked on the Edges; with Threads in the Middle, that in their native Country turn to *Chesnuts*; but rarely with us.

It is valued for the fair green Leaves and Flowers; and for want of Nuts is propagated by Suckers: Its Name comes from the Property of the Nuts, which in *Turkey* are given to Horses for their Provender, to cure such as have Coughs, or are broken-winded.

Mr *Chomel* says, that nothing seems to him more agreeable, or that would bring more Profit to a Country, than *Chesnuts* planted in Rows, well managed, and kept in good order; which would not only be pleasing to the Eye, but the Flower would be agreeable to the Smell, and the Taste in Time will also be gratified.

These Trees are of quick Growth, they shoot up in a little Time, and their Leaves, which are very fair and beautiful, will form a Shade, which will invite People to retire under them.

In some Places he tells us, that *Chesnut-Trees* grow like Oaks, and make Forest Trees; they likewise plant them at a Foot Distance one from the other, like young Oaks for Coppice and Underwood; but this is rarely done, because they are not good for burning, by reason of their crackling in the Fire, and Aptness to burn Peoples Clothes that sit at it.

As to the particular Uses of *Chesnut* Timber, they are next to the Oak, most coveted by Carpenters and Joiners; and formerly most of our antient Houses in *London* were built of it, there being a large Forest of them not far from this City in the Reign of our King *Henry II.*

It makes the best Stakes and Poles for Palisadoes, Pediments for Vine Props and Hops; it is also proper for Mill-Timber and Water-Works, or where it may lie buried.

It is so prevalent against Cold, that *Chesnut-Trees* defend other Plantations from the Injuries of the severest Frosts.

The *Chesnut-Tree* is also proper for Columns, Tables, Chests, Chairs, Stools, Bedsteads, and Wine-Casks, and those for other Liquors, giving the Liquor the least Tincture of the Wood of any whatsoever; and having been dipped in scalding Oil, or well pitched, is extremely durable. It will look fair without, indeed, when rotten within; however, the Beams give warning of a fall of a House by their cracking.

The Coals of this Wood are excellent for the Smith, soon kindled, and as soon quenched.

CHIMNEY, that Part of a Room, Chamber, or Apartment, wherein the Fire is made.

Chimneys consist of these following Parts: The Jaumbs or Sides coming out perpendicularly, sometimes circularly, &c. from the Back, the Mantletree, which rests on the Jaumbs; the

Tube or Funnel which conveys away the Smoke; the *Chimney-Piece* or Moulding, which is on the Foreside of the Jaumbs over the Mantletree, and the Hearth or Fire-Place.

Palladio lays down the following Proportions for the Breadths and Depths of *Chimneys* on the Inside, and for that Height to the Mantletree.

<i>Chimneys</i> in	Breadth.	Height.	Depth.
Halls,	6, 7, or 8 Feet.	$4\frac{1}{2}$, or 5 Feet.	$2\frac{1}{2}$ or 3 Feet.
Chambers,	$5\frac{1}{2}$, 6, or 7 Feet.	4, or $4\frac{1}{2}$ Feet.	2, or $2\frac{1}{2}$ Feet.
Studies and Wardrobes.	$4, 4\frac{1}{2}$, or 5 Feet.	4, or $4\frac{1}{2}$ Feet.	2, or $2\frac{1}{2}$ Feet.

Wolfius orders the Breadth of the Aperture at Bottom to be to the Height as three to two, to the Depth as four to two.

In small Apartments the Breadth is three Feet, in Bed-Chambers four, in larger Apartments five, in small Banqueting Rooms five and a half, in large six.

But the Breadth must never exceed two and a half, lest there being too much Room for Air and Wind, the Smoke be driven into the Room: Nor must the Height be too little, lest the Smoke miss its Way, and be check'd at first setting out.

The same Author advises to have an Aperture, through which the internal Air may, on Occasion, be let into the Flame to drive up the Smoke, which the internal Air would otherwise be unable to do.

Some make the Funnel twisted, to prevent the Smoke's descending too easily; but the better Expedient is to make the Funnel narrower at Bottom than at Top, the Fire impelling it up more easy when contracted at the Bottom; and in mounting it finds more Space to disengage itself, and therefore will have less Occasion to return into the Room.

Mr. *Felibien* orders the Mouth of the Tube, or that Part joined to the *Chimney-Back*, to be a little narrower than the rest; that the Smoke coming to be repelled downwards, meeting with this Obstacle, may be prevented from getting into the Room.

To prevent smoaking *Chimneys*, Mr. *Lucar* advises to leave two Holes, or make two Pipes in the *Chimneys* one over the other on each Side, the one flopping

ping upwards, and the other downwards; thro' these Holes or Pipes, says he, the Smoke will easily pass out of any Funnel which way soever the Wind blows.

Philip D'Orme advises to provide a hollow Brass Ball, of a reasonable Capacity, with a small Hole in one Side for the putting in Water, to be hung up in the *Chimney*, at a Height a little above the greatest Flame, (with the Hole upwards,) by an Iron Wire that shall traverse the *Chimney* a little above the Mantletree; where, as the Water grows hot, it will rarefy and drive thro' the Aperture or Hole in a vapoury Steam, which will drive up the Smoke that would otherwise linger in the Funnel.

Some think it would be better if this Brass Ball were made with a short Nose to screw off when it is to be fill'd with Water; and then the Hole at the End of this Nose need not be bigger, than that at the small End of a Tobacco-Pipe.

It also may be proper to have two of these Balls, one of which may supply the Place of the other when it is exhausted; or, upon Occasion, to blow the Fire in the mean Time.

Others place a kind of moveable Vane or Weather-Cock on the Top of the *Chimney*; so that what Way soever the Wind comes, the Aperture of the *Chimney* will be skreen'd, and the Smoke have free Egress.

Indeed the best Prevention of a smoking *Chimney* seems to lie in the proper placing of the Doors of a Room, and the apt falling back of the Back, and due ga-

thering of the Wings and Breast of the *Chimney*.

Rules about Timbers near *Chimneys*: It is a Rule in Building, that no Timber be laid within twelve Inches of the Foreside of the *Chimney* Jaumbs; that all the Joists on the Back of any *Chimney* be laid with a Trimmer, at six Inches distance from the Back; that no Timber be laid within the Funnel of any *Chimney*.

Chimney Hooks, are Hooks of Steel and Brass, put into the Jaumbs of *Chimneys*, into each Jaumb one, for the Handle of the Fire Tongs and Fire Pan to rest in.

Their Price: The Steel Hooks are about 1 s. the Pair, and the Brass about 2 s. the Pair in *London*.

Chimney Jaumbs, are the Sides of a *Chimney*, commonly standing out perpendicularly (but sometimes circularly) from the Back, on the Extremities of which the Mantletree rests. See CORNER-STONE.

Chimney-Piece, is a Composition of certain Mouldings of Wood or Stone, standing on the Foreside of the Jaumbs, and coming over the Mantletree.

The Price: *Chimney-Pieces* of Free-Stone, wrought plain, are worth 10 s. but there may be such Mouldings wrought in them, as with their Coves, and other Members, may be worth 20, 30, or 40 s. per Piece.

Chimney-Pieces of Egyptian Marble, or black-fleak'd Marble, or of Rome, or liver-coloured Marble, (of an ordinary Size,) are worth twelve or fourteen Pounds per Piece.

Chimney-

Chimney-Pieces of Wood, are also of different Prizes, as from ten to twenty Shillings a Piece, more or less, according to their Size, Goodness of the Stuff, and Curiosity of Workmanship.

The Price of painting *Chimney-Pieces*: They are usually painted by the Piece, at about two Shillings each, more or less, according to their Magnitude, and Goodness of the Work.

In the Year 1713 was published a *French Book*, intitled, *La Mechanique du Feu*; or, The Art of augmenting the Effects, and diminishing the Expence of Fire, by *M. Gauger*, which was since published in *English* by Dr. *Desaguliers*; in which the Author examines what Dispositions of *Chimneys* are most proper to augment the Heat; and also proves geometrically, that the Dispositions of parallel Jaumbs, with the Back inclined as in the common *Chimneys*, is less fitted for reflecting Heat into a Room, than parabolical Jaumbs, with the Bottom of the *Tablette* horizontal.

He also gives several Constructions of his new *Chimneys*, and the manner of executing or making them.

Of measuring *Chimneys*: Bricklayers commonly agree for building of *Chimneys* by the Hearth; yet they sometimes work them by the Rod, as in other Brick-Work, and then their Method of taking the Dimensions is as follows:

If you are to measure a *Chimney* standing alone by itself, without any Party Wall adjoin'd, then girt it about for the Length, and the Height of the Story is

the Breadth; the Thickness must be the same the Jaumbs are of, provided that the *Chimney* be wrought upright from the Mantletree to the Cieling, not deducting any thing for the Vacancy between the Floor (or Hearth) and the Mantletree, because of the Gatherings of the Breast and Wings, to make Room for the Hearth in the next Story.

If the *Chimney-Back* be a Party Wall, and the Wall be measured by itself, then you must measure the two Jaumbs and the Breast for a Length, and the Height of the Story for the Breadth, at the same Thickness the Jaumbs were of.

When you measure *Chimney-Shafts*, girt them with a Line round about the least Part of them for the Length, and the Height will be your Breadth.

And if they be four Inch Work, then you must set down your Thickness at one Brick-Work; but if they be wrought nine Inches thick, (as sometimes they are, when they stand high and alone above the Roof,) then you must account your Thickness one Brick and half, in consideration of Wyths and Pargetting, and Trouble in Scaffolding.

It is customary in most Places, to allow double Measure for *Chimneys*.

For Example: Suppose the following Figure A B C D E F G H I K L to be a *Chimney* that has a double Funnel towards the Top, and a double Shaft, and is to be measured according to double Measure.

I first begin with the Breast-Wall I L, and the two Angles
L K

C H

LK and HI, which together are eighteen Feet 9 Inches; then I take the Height of the Square HF twelve Feet six Inches, which multiplied together, produce 234 Feet 4 Inches, six Parts for the Content of the Figure FGHK. As for the Square Da Eb, the Length of the Breast-Wall, and two Angles, is fourteen Feet six Inches, and Height Da nine Feet; which multiplied together, make 130 Feet six Inches for the Content of the Part Da Eb. Then the Height of the next Square seven Feet, and the Length of the Breast-Wall and two Angles is ten Feet three Inches; which multiplied together, produce seventy Feet nine Inches for the Content of the Square Bc ed.

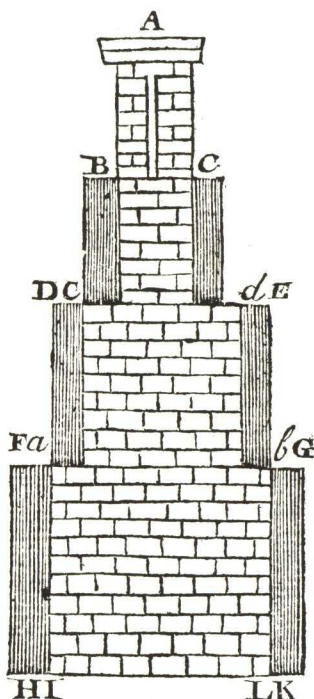
The Compaſs of the *Chimney* Shafts is thirteen Feet nine Inches, and the Height ſix Feet ſix Inches; which multiplied together, produce eighty-nine Feet four Inches, ſix Parts, the Content of the Shafts.

The Depth of the middle Fetter that parts the Funnels is

The Work.	
F.	I.
18	9
12	6
225	0
FGHK	9 4 6
234	4 6
F.	I.
14	6
9	0
Da Eb	130 6

C H

twelve Feet, and its Width one Foot three Inches; which mul-



tiplied together make fifteen Feet the Content thereof.

The Work.	
	18.75
	12.5
	9375
	3750
FGHK	1875
Product	234-375
	14 5
Da Eb	130 5

F. I.

C H

		F.	I.
		10	3
		7	0
Bc Cd	71	9	
	F.	I.	
	13	9	
	6	6	
	82	6	
	6	10	6
The Shaft	89	4	6
	F.	I.	
	1	3	
	12	0	
The Fetter	15	0	
272) 1082 (3 Rods.			
68) 266 (3 quarters.			
Rem.	62	Feet.	

C H

		10	25
		7	
Bc Cd	71	75	
	13	75	
	6	5	
	68	75	
	82	50	
The Shaft	89	375	
	1	25	
	12		
	15	00	
	F.	I.	P.
FGHK	234	4	6
Da Eb	130	6	0
Bc Cd	71	9	0
The Shaft	89	4	6
The Fetter	15	0	0
The Sum	541	0	0
The Double	1082	0	0

When the five Products have been produced together, the Sum is to be doubled, and that double Sum is the Content of the *Chimney* in Feet, according to the double or customary Measure ; which Feet must be reduced to Rods, as directed in reducing Feet to Rods.

So the Feet in the foregoing Example being reduced to Rods, (the Thickness being supposed one Brick and a half,) it makes three Rods three quarters, and sixty-two Feet ; that is, four Rods wanting two Feet. This

is all the Measure that can be allowed, when a *Chimney* stands in a Gable or Side-Wall ; in which Case the Back of the *Chimney* (here not mentioned) is accounted as Part of the Gable ; but if the *Chimneys* stand by themselves, as all Stacks of *Chimneys* in great Buildings do, in such Case it is all *Chimney-Work*, and therefore ought to be measured double on all Sides.

The Price : *Chimneys* are sometimes measured and paid for by the Rod, like other Brick-Work ; and sometimes by the Fire-Hearth,

at

at so much *per* Hearth, and the Price is various, from 20 to 50*s.* *per* Hearth.

Mr. *Wing* says, that building of *Chimneys* for ordinary Buildings, with Architrave, Frize, and Cornish, is worth from 15 to 20*s.* *per* Hearth, according to their Height and Substance; and without Architrave and Frize, from 10 to 20.

He adds, that in great Buildings they are usually done by the Feet, *viz.* at about 6*d.* *per* Foot.

They are commonly built in *London*, and some other Places, for about fifteen Shillings a Hearth; and some say, they have twenty and twenty-five Shillings *per* Hearth for building in *Sussex*.

M. *Gauger* has given us a new Treatise of *Chimneys*, and has shewn a Way how to build them for the most Conveniency. He has shewn you how you may readily light a Fire, if you would have it always blaze, what Wood you should burn, how to warm you on all Sides, though never so cold, and and yet without scorching; how always to breath fresh Air, and of what Degrees of Heat you please; how to keep the Room ever free from smoaking, and without any Damp; and how to put out a Fire that has catched the Funnel of a *Chimney* in a Moment.

All these Conveniencies depend upon the Disposition of the Hearth, Jaumbs, and the Funnel upon an Iron or Copper-Plate, apply'd in such a Manner, that it leaves a void Space behind, through which the exter-

nal Air that should go into the Room, passes, and warms, upon a Trap which serves instead of a Pair of Bellows, upon a Bascule or Swipe, which is fitted to the Funnel of the *Chimney*; and the particular Way of forming the upper End of the Funnel of some *Chimneys*.

A Model of a Hearth and Jaumbs for the Increase of Heat.

Suppose the Space between the Extremities of the Jaumbs, taken on the Side of a Room be 4 Feet, and the Depth of the *Chimney* twenty Inches, which is the common Size of *Chimneys*; and if there are those which are larger or smaller, they increase or diminish the Lines by which they would determine.

Take a Board, suppose AB, *b a*, four Foot long and twenty Inches broad, whose Sides must be drawn by a Rule one upon another, or a square Draught made in the Middle of M of the Side B*b*, mark the Length MC eleven Inches, and from C, mark upon the same Side, the Length CG, which must be four or five Inches long. See the Plate.

From the Point H, draw H*p*, by a Rule upon the Line GHA: From the Point G, draw also Cp, by your Rule upon the Line BM, upon the Point P, where these two Lines drawn by the Rule, meet as in a Centre; and from the Distance PH, or PC, describe the Arch HC: Do the same Thing on the other Side Mb, in order to describe the Line *cba*.

Then

Then, within three Inches of this rectangular Figure, trace another, as at Z, 3 Inches long, and two and a half broad. These two rectangular Figures ought to answer to the Middle M of Cc, cut off the Draught upon the Board marked A H, C m, c b a; and so you will have your Model for the *Chimney*.

The Great Rectangle X will serve as a Model for the Ash-Pan, which must be dug in the Hearth, of a convenient Depth, if you have a Mind to have one.

The small rectangular Figure Z serves to be a Model for a Pair of Bellows of a new Invention.

The Hearth is to be opened here; and this Opening is to yield a Passage to the Wind that comes from the Street, or some other convenient Place, by the Means of a Funnel or Pipe concealed in the Floor of the Room.

This Hole or Opening is to be furnished with an Iron, or Copper Frame; to which is fastened a small Trap-Door, that shuts close, and lies open towards the Fire; the Sides of the Frame and Trap are made slope and Bevel-wise; on the Side opposite to the Turning-Joint or Hinge, with which the Trap-Door is fastened to the Frame, is placed a small Button, that you may lift this Trap-Door with the Tongs; and you may put on a Button: There will be below on both Sides the Trap, a small Part of a Circle, whose Centre must touch the Hinge, that the Wind may not get out another Way than before, and towards the Fire, when the Trap-Door

VOL. I.

is lifted up; and to the End it may be kept open to such a Height as you think proper, and yield more or less Wind: Two small Springs must be fastened under the Frame, each of which must rest upon some Parts of the Circle, and press them so, that the Trap-Door may be kept up.

Let the Bottom of the Tablet or little Board be placed parallel to the Horizon, according to its Breadth, or Level that Way; for it may be arched; and it must not be above ten or twelve Inches distant from the Bottom of the *Chimney*, to the End that the Funnel of the *Chimney* may have no more Breadth in that Place.

If the Funnel is loose, you must have Languets or Tenons on the Sides, in some Parts of the Circles, from the Top of the Jaumb to the Floor.

In building or forming the Bottom of the *Chimney*, so that the Air may come into the Room hot, you must make use of a single Copper or Iron Plate or Back made of several Sheets about four Feet long, and three and a half high; furnish'd with several Iron Bands, which must be five Feet broad, and not so high by ten Inches, as the great; apply them to it in such a Manner, that the first Band may reach from the Top to within ten Inches of the Bottom, that the second may have the same Distance from the Top as the first has from the Bottom; that the third be placed in the same Manner as they first, are represented in the First Figure.

P

It

It would be convenient, if you can, to hollow the Wall as much as is necessary, that the Back may not be too forward; but be that as it will, there must be made, as it were, two Gutters an Inch deep in the Wall, which may answer the Tenons that may enter in, which are to be filled with very fresh Mortar, and a Space must be left between the Wall and the Back, four Inches deep.

It would, perhaps, be more convenient to make a Caisse or Box of Iron, furnished with Tenons of the Dimensions aforesaid, and to fasten it in the Bottom of the *Chimney*; you may also order as many little Cells as you please, but there must not be fewer than ten or twelve Inches Distance between the Tenons; and Matters must be so contriv'd, that the second little Cell be bigger than the first, and the third than the second and so of the rest.

This Box should have but two Openings; one at the Bottom, at D; and the other on the opposite Side above, at R.

In framing the *Chimney*, you must make a Conduit-Pipe, which must be open to a Street or Court, and be about a Foot square; this Pipe will convey the cold Air as far as D, yet not without the Use of the particular Instrument at R before described. From D, it enters into the Box, where it runs windingly through all the Cells formed by the Tenons or Languets: It grows warm there, and comes out at the Hole R, at the Corners of the Tablet; in-somuch, that the Heat of the

Room may be augmented or diminish'd, according as you partly stop, or open the Hole, which need be but two Inches Diameter.

If you have a Mind to heat some particular Part of a Room, suppose a Person sick in Bed, you may apply a Tin Pipe to this Hole, by which you may also convey the warm Air into another Room; perhaps, a Leather, or Pasteboard one may do.

Lastly, if the Heat is not sufficient, you may cause the little Cells of this Box to pass under the Hearth, and under the Tablet.

When once the Work described is understood, there will be no Difficulty to make it serve in all Parts of the Hearth, where you think it may contribute to increase the Heat.

But if you cannot possibly be able to adjust the little Cells in the Bottom of the *Chimney*, you must content your self to do it in the Jaumbs, under the Hearth and little Board.

As to the forming of the upper Part of the *Chimney*, to prevent its smoking, you must first observe, that your *Chimney* be not commanded by any Thing; that is, that there are no Buildings about it higher than the Funnel: You must also place your Funnels one by the Sides of another, as the common Practice is. Suppose that the Funnel within be thirty Inches long, and the Breadth ten, make a Ledge of two Inches, sloping underneath, quite round and within; the Opening will be no more than twenty-six Inches long, and six broad; divide this Length into
to

to three Parts by two Partitions, each of four inches; the lowermost Part of which will descend Anglewise into the Pipe; each of the three Openings will be six Inches Square.

Make three curtail'd square and hollow Pyramids, the Basis of each of which within will be eleven or twelve Inches square, and the Height from twelve to fifteen Inches; divide this upper Opening by a small Languet of two or three Inches in Height, which you are to place different Ways: You are also to apply and fix these three Pyramids near one another, over the three Openings you have contriv'd on the Top of the Funnel of the *Chimney*. If the Opening of the *Chimney* is too small, which is scarcely to be supposed, you must lessen the Apertures of the Pyramids, and if it be too big, you must enlarge them, or instead of three, use four.

These Pyramids may be made of Tin, Clay, or Potters Earth, bak'd, as you do other Earthen Ware.

You may fit a Cap to these Pyramids, made in such a Manner, that being higher, it may serve to suspend a Body above the Opening of the Pyramid, made in the Form of a triangular Prism, one of the Angles of which must be turned towards the upper Openings of the Pyramids, and the Smoak gets out thro' the Sides. It will be best to make all those Pieces of Tin.

The Swipe is an Iron-Plate, placed in some Part of the Funnel of the *Chimney*: It should be

exactly of the Length and Breadth of that Place, where you put it, that it may stop it exactly.

To the Middle of this Swipe two Trunnions or Knobs are to be fitted, which are put into the Wall; by the Help of which, you may fit it where you please to have it; and draw it with two Wires that are fastened to both Ends.

This Swipe being shut, keeps the Heat in the Room, when the Fire is covered, and there is no Smoke: It likewise hinders the Smoke of the neighbouring *Chimneys*, to enter in, as it very often happens when there is no Fire in the Hearth: You may likewise use it to extinguish it, when a *Chimney* is set on Fire, having no more to do, than to take out the Coals or hot Embers, and shut the Swipe.

The Wood most proper to burn, is that which is called Float-Wood; which has less Heat, and burns quicker than new Wood.

Float, Beech, or Bakers Billets, burn faster than the other.

Green Wood will not burn so well as dry; it grows black in the Fire, causes much Smoke, and is hard to be lighted. Whitewood, and the Poplar, Birch, Aspen, &c. are the worst of all Woods to burn.

If there is a Distinction to be made between Oak, young Oaks burn and heat much, the old grows black in the Fire, makes a sort of scaled Coal, that yields no Heat, and is soon put out.

Thus in using Oak for Firing, you must chuse Billets of three or four Inches Diameter. The Oak, whose Bark is taken off for the Tanners Use, burns well enough, but yields very little Heat.

Yoke-Elm burns well, makes a good Fire, and a good many red-hot Brands, which last long.

The best of all Woods, is new Beech, which makes a good clear Fire, and but little Smoke, when well ordered: It yields a good deal of Heat, and many good Embers.

CHISSEL, an Instrument much used in Carpentry, Joinery, Masonry, Sculpture, &c.

Chissels are of different Kinds; and have different Names, according to the different Uses they are apply'd to. As,

1. The *Former*, which is used in Carpentry and Joinery, first of all before the *Paring Chissel*, and just after the Work is scrib'd.

2. The *Paring Chissel* which has a fine smooth Edge and is used in paring off, or smoothing the Irregularities, which are made by the Former. This is not struck with a Mallet, as the Former is, but is pressed with the Workman's Shoulder.

3. The *Skew-Former*, which is used in cleansing acute Angles with the Point or Corner of its narrow Edge.

4. The *Mortice-Chissel*, which is narrow, but very thick and strong, to endure hard Blows; and 'tis cut to a very broad Basil; its Use is cutting deep square Holes in Wood for Mortices.

5. The *Gouge*; which is a *Chissel* with a round Edge, one Side of which serves to prepare the Way for an Augre; and the other to cut such Wood as is to be rounded, hollow'd, &c.

5. *Socket-Chissels*; which are chiefly used by Carpenters, &c. having their Shank made with a hollow Socket at Top, to receive a strong Wooden Sprig fitted into it with a Shoulder.

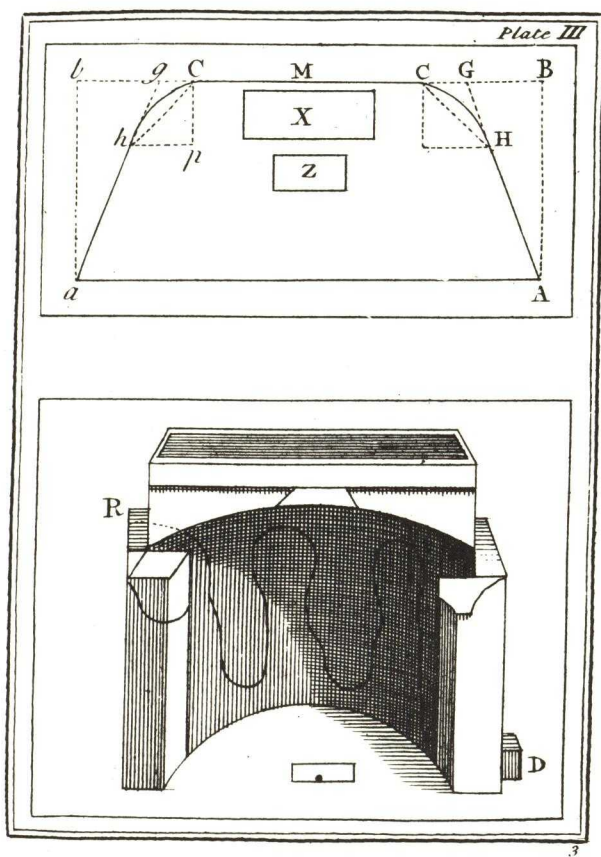
These *Chissels* are also distinguish'd according to the Breadth of the Blade, into Half-Inch *Chissels*, quarter of an Inch *Chissels*, &c.

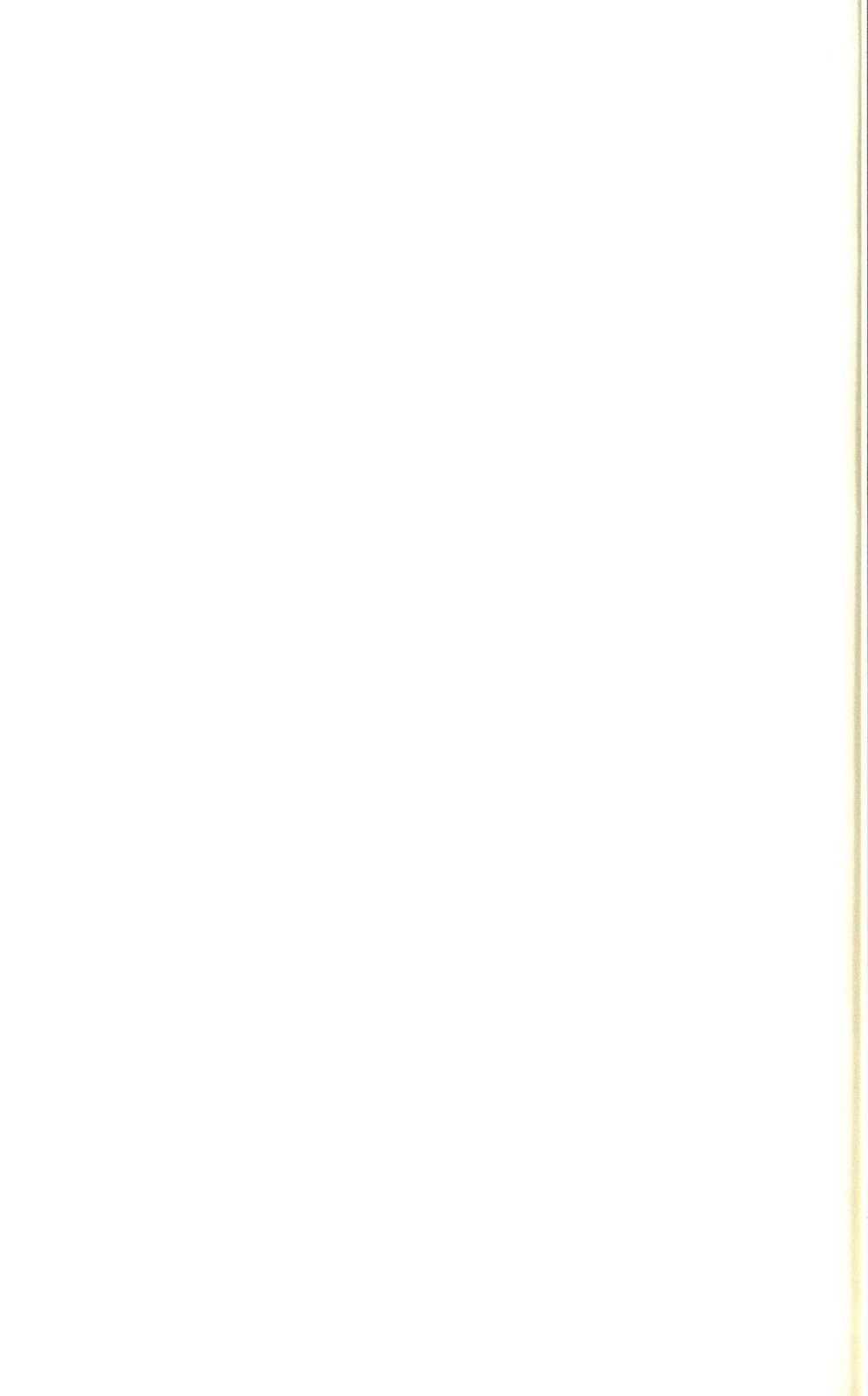
7. *Ripping Chissel*; which is a *Socket Chissel*, an Inch broad, having a blunt Edge with no Basil to it, for ripping and tearing two Pieces of Wood asunder, by forcing in the blunt Edge between them.

CHOIR, is that Part of a Church, Cathedral, &c. where the Priests, Choristers, and Singers sit.

The *Choir* is distinguish'd from the Chancel, or Sanctuary, where the Communion is celebrated; as 'also from the Nave or Body of the Church, where the People assist.

CHORD [in Geometry] is a Right Line connecting the two Extrems of an Arch; or it is a Right Line terminated at each Extream in the Circumference of a Circle, without passing through the Centre, and dividing the Circle into two unequal Parts called Segments, as the Line AB in the Figure.

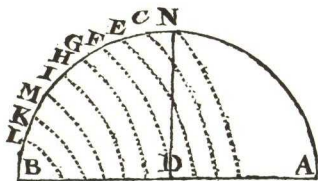




The *Chord of an Arch* is a Right Line drawn from one Extremity of an Arch to the other; called also the *Subtenſe*.

To make a Line of Chords for the Meſuration of the Quantity of Angles.

First, Draw a Right Line at Pleaſure, as AB, and from any Point, as D, raiſe the Perpendicular DN, and compleat the Quadrant DNB of any given Magnitude.



Secondly, Divide the Arch NB into ninety equal Parts, and then ſetting one Foot of the Compaſſes in B, and extending the other to the ſeveral Diviſions of the Arch, transfer them to the Line AB, as the ſeveral Diviſions of the Arch, and transfer them to the Line AB, as the ſeveral pricked Arches L 10, 20, 30, 40, &c. exhibits; which will compleat the Line of Chords requir'd.

N. B. The larger theſe Scales are made, the better they are for Praſtice.

CHURCH, is defined by *Daviler*, to be a large Veſſel extended in Length, with Nave, Choir, Iſles, Chapel, and Belfry.

A Simple Church, a Church ſo called, having only a Nave and a Choir.

A Church with Iſles is one which has a Row of Porticoes in Form of Vaulted Galleries, with Chaplets in the Pourtour.

Church in a Greek Croſs is one the Length of whoſe Croſs is equal to that of the Nave; ſo called, becauſe moſt of the Greek Churches were built in this Form.

Church in a Latin Croſs, is one whoſe Nave is longer than the Croſs, as moſt of the Gothic Churches.

Church in Rotondo, one whoſe Plan is a perfect Circle, in Imitation of the Pantheon.

CIMA, or SIMA, a Member or Moulding; called alſo *Cymatium*, and *Gula*: Which See.

CIMBLY. See PEDESTAL.

CILERY, a Term in Architecture, ſignifying the Drapery or Levage that is wrought upon the Heads of Pillars.

CIMELLARC, in Architecture, is a Veſtry, or Room, where the Plate, Veſtments, and other rich Things belonging to the Church, are kept.

CINCTURE, ? i.e. a Girdle

CEINTURE, S in Architecture, a Ring, Liſt, or Orlo, at the Top and Bottom of the Shaft, at one End from the Baſe, and at the other from the Capital.

That at the Bottom is particularly called *Apophyges*, as if the Pillar took its Height from it; and that at Top, *Colarin*, or *Collar*, or *Colier*, and ſometimes Annulus.

The Cincture is ſuppoſed to be in Imitation of the Girts or

Ferrils, which were used by the Antients to strengthen and preserve the primitive Wooden Columns.

CIPHER, γ one of the Numerical Characters, in this Form 0.

The *Cypher*, in itself, implies a Privation of Value; but when placed with other Characters on the Left Hand of it, in the common Arithmetick, it serves for augmenting each of their Values by ten; and in Decimal Arithmetick, lessens the Value of each Figure at the Right thereof in the same Proportion.

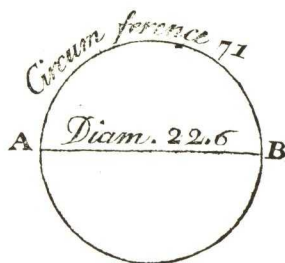
CIRCLE, is a plain Figure contain'd under one Line, which is called a Circumference, unto which all Lines drawn from a Point in the Middle of the Figure, call'd the Centre, and falling upon the Circumference of it, are all equal the one to the other. The Circle contains more Space than any plain Figure of equal Compaits.

Problem I. hath the Diameter and Circumference to find the Area.

The RULE.

Every Circle is equal to a Parallelogram, whose Length is $\equiv$ to half the Circumference, and the Breadth equal to half the Diameter; therefore multiply half the Diameter, and the Product is the Area of the Circle.

Thus if the Diameter of a Circle (that is the Line drawn cross the Circle through the Centre,) be 22.6 and if the Circumference be 71, the Half of 71 is 35.5, and the Half of 22.6 is 11.3, which multiplied together, the Product is 401.15, which is the Area of the Circle.



35.5 Half Circumf.
11.3 Half Diamet.

1065
255
355

401.15

DEMONSTRATION.

Every Circle may be conceiv'd to be a Polygon of an infinite Number of Sides, and the Semidiameter must be equal to the Perpendicular of such a Polygon, and the Circumference of the Circle equal to the Periphery of the Polygon; therefore half the Circumference multiply'd by half the Diameter, gives the Area as aforelaid.

Or (with *F. Ignatius Gaston Pardies*,) every Circle is equal to a Rectangle Triangle, one of whose Legs is the Radius, and the other a Right Line equal to the Circumference of the Circle: For such a Triangle will be greater than any Polygon inscribed, and less than any Polygon circumscribed (by the 24th, 25th, 26th, and 27th Articles of the *Fourth Book of his Elements of Geometry*)

Geometry) and therefore must be equal to the *Circle*.

For, says he, should it be greater than the *Circle*, be the Excess as little at it will, a Polygon may be circumscribed, whose Difference from the *Circle* shall be yet less than the Difference between that *Circle*, and the Rectangle-Triangle; and that that Polygon will be less than the Triangle, is absurd: And if it be said, that this Rectangled-Triangle is less than the *Circle*, an inscribed Polygon may be made, which shall be greater than that Triangle; which is impossible.

This cannot but be admitted as a Principle, That if two determinate Quantities A and B, are such, that if every imaginable Quantity, which is greater or less than A, is also greater or less than B, these two Quantities, A and B, must be equal.

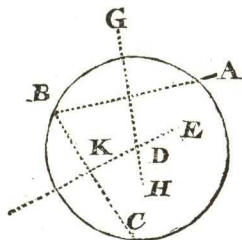
And this Principle being granted, which is in a manner, self-evident, it may be directly prov'd, that the Triangle before mentioned is equal to the *Circle*; because every imaginable inscribed Figure, which is less than the *Circle*, is also less than the Triangle; and every circumscribed Figure greater than the *Circle*, is also greater than the Triangle.

Problem II. having the Diameter of a *Circle* to find the Circumference.

As 7 to 22, so is the Diameter to the Circumference; or as 113 to 355, so is the Diameter to the Circumference.

To describe a *Circle*, whose Circumference shall pass through any three given Points, provided they are not in a Right Line, as the Points ABC.

First, Draw two Right Lines from A to B, and from B to C, it matters not which; then divide those two Right Lines con-

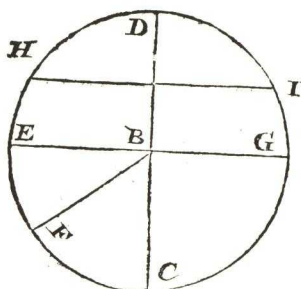


tain'd between the three Points, each into two equal Parts, by the Perpendicular GH, and FE, which will intersect each other in D, the Centre of the *Circle* that will pass through the Points.

Secondly, Set the Compasses in D, and extend the Foot to A, and then describe the *Circle* requir'd.

A *Circle* is generated by the Fluxion of a Line, whose Centre being exactly in the Middle of it, all Right Lines drawn from thence to the Circumference, are equal.

2. All Right Lines which pass through the Centre of a *Circle*, as DC, or EG, are called Diameters, and divide its Superficies into two equal Parts, which are called Semicircles; as the Diameters DBC, which dividing



the *Circle* EDGC into two equal Parts, do thereby constitute the two Semicircles EDG, and GCE, therefore a Semicircle is a Figure contained under the Diameter, and that Part of the Circumference which is cut off by the Diameter.

3. Half the whole Diameter of a *Circle* is called the Semiciameter, or Radius, of the *Circle*, as EB, DB, GB, CB, &c.

4. A Segment, Section, or Portion of a *Circle*, is a plain Figure or Superficies contained under a Right Line (which is less than the Diameter,) and Part of the Circumference, either greater or less than a Semicircle.

As for Example: The Right Line HI cutting off the upper Part of the *Circle* HDI, does thereby divide the whole *Circle* into two unequal Parts, which are called Segments, Sections, or Portions; as HDI, the lesser contained under the Line HI, and Part of the Circumference HDI, which is less than the Semicircle ADC and HCI under the Line HI, and the remaining Part of the Circumference

HECI, which is greater than the Semicircle ECG.

5. The fourth Part of a *Circle*, as EBD, or DBG, &c. is called a Quadrant, being contain'd under two Semicdiameters (which are called the Sides) and the fourth Part of the Circumference, which is called the Limb of the Quadrant.

6. A Sector of a *Circle* is a Figure contained under two Semicdiameters, (as BF and BE,) and Part of the Circumference FE contain'd between the Circumference of every *Circle* is supposed to be divided into 360 equal Parts, which are called Degrees; therefore as a Quadrant is one fourth Part of a *Circle*, the Degrees contained in it, are 90; and a Semicircle therefore contains 180 Degrees.

8. Every Degree of a *Circle* is supposed to be subdivided into 60 equal Parts, which are called Minutes; therefore one Fourth of a Degree contains 15 Minutes, half a Degree 30 Minutes, three Fourths of a Degree 45 Minutes, &c.

9. All Right Lines (less than the Diameter,) which divide Circles into Portions as HI are called Chord-Lines, or Subtense Lines, of those Arches, which they subtend; because they subtend both Segments, that is, the Line HI is common as well to the Segment HECGI, as to the Segment HDI.

10. Those Parts of the Circumference of *Circles*, which are contain'd between the Extrems of Chord-Lines, as HDI, or EDG are called Arches, or Arch-Lines.

11. The

11. The Complement of an Arch to a Quadrant or 90 Degrees is so much as an Arch wants of 90 Degrees: As for Example, the Complement of the Arch GI is the Arch ID , and the Complement of the Arch HE is HD ; also in Number of Degrees, the Complement of 40 Degrees is 50 Degrees; because that 40 Degrees is less by 50 Degrees, than 90 Degrees: So likewise is 40 Degrees the Complement of 50 Degrees, and 10 Degrees the Complement of 80 Degrees; and the like of any other Quantity of Degrees whatsoever.

12. The Complement of any Number of Degrees and Minutes to 90 Degrees is the Quantity of Degrees and Minutes which are wanting to make their Sum 90 Degrees compleat.

As for Example: The Complement 27 Degrees 16 Minutes, being subtracted from 90 Degrees, the Remainder will be 62 Degrees, 44 Minutes; and the like of any other Quantity.

13. The Excess of an Arch, greater than a Quadrant, is so much as the said Arch exceeds 90 Degrees.

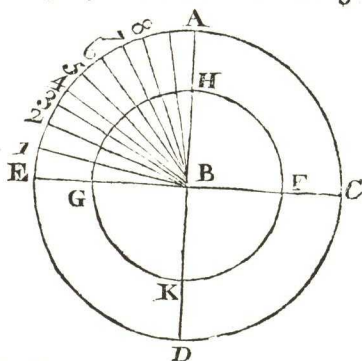
As for Example: The Excess of the Arch EDI is the Arch DI ; because when the Arch ED (which is a Quadrant) is taken from EDI , the Remainder is DI , which is the Excess more than the Quadrant EHD .

14. The Complement of an Arch less than a Semicircle, is so much, as that Arch wants of a Semicircle or 180 Degrees.

As for Example: The Arch EH is the Complement of the Arch HDG : So likewise is CEH the Complement of the

Arch HD , and HDG is the Complement of the Arch HE .

To divide the Circumference of the Circle $CAED$ into 360 equal Parts or Degrees, by which the Quantities of all Angles are measured: *First*, Describe a Circle of the given Magnitude, as $ACED$, and draw the two Diameters CE and AD at Right Angles, to each other through



its Centre; then will the Circumference of the Circle be divided into four equal Parts, at the Points $CAED$, and consequently the Circle into four Quarters, each of which is called a Quadrant, as ABC , or ABE , &c.

Secondly, Make $A3$ and $E6$ equal to the Radius BE , or AB , then will the Arch AE be divided into three equal Parts, each = 30 Degrees.

And here observe, That as this Division of the Arch AE was made by the Radius AB being set from A to 3, and from E to 6; therefore it is plain, that as thereby the Arch is divided into three equal Parts, each containing a Third of 90 Degrees, the Radius AB must = 60 Degrees of the Arch AE .

There,

Therefore hereafter, when the Radius of a *Circle* is mention'd, the Arch of 60 Degrees is to be understood by it at the same Time.

Thirdly, With the Compasses divide E 3, 36, and 6 A, each into three equal Parts; and each of those Parts into ten equal Parts (there not being yet any Geometrical Method of dividing an Arch otherwise,) then will the Quadrant AE be divided into 90 equal Parts; and consequently if the other three Quadrants ACB, CBD, and BED, be divided in like manner, the Whole will be divided into 360 equal Parts, as required.

It is by the Number of Degrees contained in every Arch of an Angle, that its Quantity is measured.

Thus the Quantity of the Right Angle ABC is 90 Degrees, the Acute Angle CBE 60 Degrees, and the Obtuse Angle CBA 120 Degrees; that is the the Arch or Quadrant CA 90 Degrees, and the Arch AB 30 Degrees; which taken together, are = 120 Degrees.

Hence 'tis plain, that all Acute Angles contain less than 90 Degrees, or a Right Angle, and all

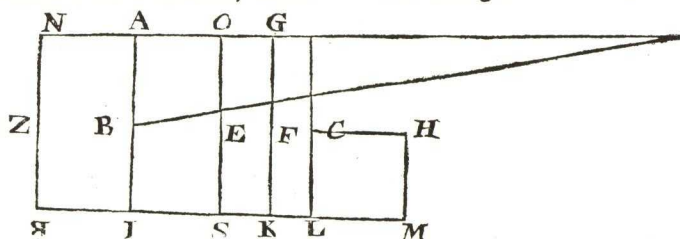
Obtuse Angles more than ninety Degrees, and less than a hundred and eighty Degrees, or two Quadrants, which taken together, are = to a Semicircle; therefore a Semicircle contains a hundred and eighty Degrees.

If from the Points, 8, 7, 5, 4, 3, 2, 1, of the Quadrant there be right Lines drawn to the Centre B; and if on the Centre B. another *Circle* be describ'd, as the *Circle* FHGK, the Quadrant HG will be divided by the Lines 8B, 7B, 6B, &c. unto the like Number of equal Parts or Degrees, as the Quadrant AC; wherefore 'tis plain, that all *Circles*, either great or small, have their Circumferences alike, divided into three hundred and sixty equal Parts or Degrees, and each of those Degrees are supposed to be again divided into sixty equal Parts called Minutes.

Every *Circle* is nearly equal to a Parallelogram, whose Length is equal to half its Circumference, and Breadth to the Semidiameter: Or every *Circle* is equal to the Parallelogram, whose Length is equal to the Diameter, and Breadth to eleven Fourteenths thereof.

Suppose the *Circle* ABI to be fourteen Feet Diameter, then I

say, that the Oblong BHIM, whose Length BH is equal to



22, the Half of the Circumference of the *Circle* AEI, and

Breadth HM, to the Semidiameter BL, is equal to the Parallelogram

rallelogram $ACIK$, whose Length CK is equal to the Diameter AI , and the Breadth to eleven Fourteenths thereof.

For HM , which is equal to seven Feet, being multiply'd into BH , twenty-two Feet, the Product or Area thereof is one hundred and fifty-four Feet. And again, AI the Diameter fourteen Feet, being multiplyed into $AC \frac{11}{14}$ thereof, *viz.* eleven Feet, the Product or Area thereof is one hundred and fifty-four Feet, as before.

Therefore those two Parallelograms are equal, and either of them nearly equal to the Area of the Circle ABI .

N.B. In the preceding Figure, there should have been a Circle describ'd on B , as a Centre, whose Diameter is BA .

Corollary 1. Hence appears the general Rule for the Mensuration of Circles; to multiply half the Circumference by half the Diameter.

Corollary 2. Hence every Semicircle is nearly equal to the Oblong or Parallelogram, whose Length is equal to half the Curve or Arch, and Breadth to the Radius or Semicircle;

That is, the Semicircle AEI is nearly equal to the Parallelogram $BHIM$, whose Length IM is nearly equal to half the Arch Line AEI , and Breadth HM , to the Semidiameter BI ; for the Parallelogram $ACBF$ is equal to half the Parallelogram $ACIK$.

Corollary 3. Hence it appears, that every Circle is nearly equal to that Right-angled Triangle, whose Base is equal to its Circum-

ference, and perpendicular to the Semidiameter thereof.

For if the Side AQ of the Parallelogram $AQBH$ be continued to X , and made equal to the whole Circumference $AEZI$, and the Hypothenuse BX being drawn, I say, that the Triangle BAX is equal to the Parallelogram $AQBH$.

For as AX is equal to twice AQ , and AB is perpendicular to AX , therefore QX the Side continu'd will be equal to BH , which is parallel to AQ , and consequently QH will be bisected in P by the Hypothenuse BX .

Now seeing that QX is equal to AQ , and PX to PB , and the Angles XOP , and BHP , both right-angled; therefore the Triangle AXB is equal to the Parallelogram $AQBH$; because the Triangle QXP is equal to the Triangle BPH .

Theorem. Every Sector of a Circle is nearly equal to a Parallelogram, whose Length is equal to the Semidiameter of the Circle, and Breadth to half the Curve or Arch Line thereof; or whose Length is equal to half the Semidiameter, and Breadth to the whole Curve or Arch Line thereof.

Let NMX be the Sector of a Circle, whose Arch Line NX is equal to five Feet, and Semidiameter NM to seven Feet, I say, that the Oblong $ANNM$, whose Length is equal to the Semidiameter NM , and Breadth, to half the Arch NX , is equal to the Oblong $HBVM$, whose Length VM is equal to the whole Curve NX , and Breadth, to half the Semidiameter BM .

For

Demonstration. Multiply half the Diameter, 7 Feet, by half the Circumference, 22 Feet; and the Product is 154 Feet, the Area of the *Circle*.

Multiply one of the Sides of the Square, as into itself, viz. 14 by 14, and the Product

will be 196, the Area of the Square.

Now by the Rule of Proportion :

As 154, the Area of the *Circle*, is to 196, the Area of the Square, so is 11 to 14.

$$\begin{array}{r}
 154 : 196 :: 11 : 14 \\
 \hline
 11 \\
 \hline
 196 \\
 196 \\
 \hline
 154 \overline{) 2156} (14 \\
 \underline{154} \\
 616 \\
 \underline{616} \\
 000 \text{ Remains.}
 \end{array}$$

Therefore the Proportion that a *Circle* has to a Square, whose Diameter and Sides are equal, is as 11 is to 14.

Corollary. Hence arises the stated Numbers and Rules, by which the Area of *Circles* are

found, when the Diameters only are given, viz.

Square the Diameter given, multiply the Product by 11, and divide the last Product by 14, the Quotient is the Area required.

As for Example :

Let the Diameter of a given *Circle* be 14, as before.

	14	
	14	
	56	
	14	
Product	196	The Diameter squared.
	11	
Multiplied by	196	
	196	
14) 2156 (154		The Area of the <i>Circle</i> as before,
	14	when half the Circumference
		was multiplied into the Semi-
	75	Diameter.
	70	
	56	
	56	
	00	

Or as 1 to 3.141539; so is the Diameter to the Circumference.

Let the Diameter (as in the former *Circle*) be 22.6; this being multiplied by 22, the Product will be 497.2; which being divided by 7, will give 71.028 for the Circumference.

Or (by the second Proportion) if 22.6 be multiplied by 355, the Product will be 8023; this being divided by 113, the Quotient is 71, the Circumference.

Or (by the third Proportion) if 22.6 be multiplied into 3.141593, the Product is 71.000018, the Circumference.

C I

$$\begin{array}{r}
 22.6 \\
 22 \\
 \hline
 452 \\
 452 \\
 \hline
 7) 4972 (71.028
 \end{array}$$

$$\begin{array}{r}
 3.1415.93 \\
 226 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 18849558 \\
 6283186 \\
 6283186 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 71.0000018 \\
 \hline
 \hline
 \end{array}$$

C I

$$\begin{array}{r}
 355 \\
 22.6 \\
 \hline
 2130 \\
 710 \\
 \hline
 710 \\
 \hline
 113) 8023.0 (71
 \end{array}$$

$$\begin{array}{r}
 791 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 113 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 113 \\
 \hline
 \hline
 \end{array}$$

$$\begin{array}{r}
 \dots \\
 \hline
 \hline
 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 7 to 22, or from 113 to 355, or from 1 to 3.14159; that Extent will reach from 22.6 to 71.

The Proportion of the Diameter of a Circle to the Circumference, was never yet exactly found, notwithstanding many

eminent learned Men have laboured very far therein; amongst which the excellent *Van Cullen* hath hitherto out done all, in his having calculated the said Proportion to 36 Places of Decimals, which are engraved on his Tombstone in St. *Peter's* Church at *Leyden*; which Numbers are these:

Diameter.

$$1.000\ 000.000.070.000.000.000.000.000.000.00.$$

Circumference.

$$3.14159.26535.89793.23846.26433\ 83279.50288.$$

Of which large Number, these 6 Places 3.14159, answering to the Diameter 1.00000, may be sufficient for these latter Proportions; as 7 to 22, 113 to 355, and 1 to 3.14159, the Reader may be at Liberty to use which of them he pleases. I shall only add, that the last two are the most exact, tho' the first is the most in use.

PROBLEM III.

Having the Circumference of a Circle, to find the Diameter.

As 1 is to 318309. so is the Circumference to the Diameter.

Or, as 355 is to 113, so is the Circumference to the Diameter.

Or, as 22 is to 7, so is the Circumference to the Diameter.

Let

C I

Let the Circumference be 71, (as in the former *Circle*) if .318309 be multiplied by 71, (as by the first Proportion) the Product will be 22.599939 for the Diameter.

Or, by the second Proportion, 113 multiplied by 71, the Pro-

$$\begin{array}{r} .318309 \\ \times 71 \\ \hline 318309 \\ 2228163 \\ \hline 22.599939 \end{array}$$

$$\begin{array}{r} 113 \\ \times 71 \\ \hline 113 \\ 791 \\ \hline 355)8023(22.6 \\ 710 \\ \hline 923 \\ 710 \\ \hline 2130 \\ 2130 \\ \hline \end{array}$$

$$\begin{array}{r} 71 \\ \times 7 \\ \hline 22)497(22.59 \\ 44 \\ \hline 57 \\ 44 \\ \hline 130 \\ 110 \\ \hline 200 \\ 198 \\ \hline 2 \\ \hline \end{array}$$

Thus by both the first Proportions, the Diameter is 22.6; but by the last it falls something short.

By Scale and Compasses.

Extend the Compasses from 314159 to 1, that Extent will reach 71 to 22.6; which is the Diameter sought.

Or you may extend from 1 to 318309.

Or from 22 to 7.

Or from 355 to 113; the same will reach from 71 to 32.6, as fore.

Note, That if the Circumference be 1, the Diameter will be 318309.

C I

duct will be 8023; which divided by 355, the Quotient will be 22.6, the Diameter.

Or, by the third Proportion, 71 multiplied by 7, the Product will be 497; this being divided by 22, the Quotient will be 22.5909, the Diameter.

PROBLEM IV.

Having the Diameter of a Circle, to find the Area.

All *Circles* are in Proportion one to another, as are the Squares of their Diameters, (by *Euclid* XII. 2.)

Now the Area of a *Circle*, whose Diameter is 1, will be 785.398, according to *Van Cullen's* Proportion before mentioned; but for Practice 7854 will be sufficient: Therefore

As 1 (the Square of the Diameter 1) is to 7.854, so is 510.76 (the Square of 22.6 the Diameter of the given *Circle*) to 401.15, (the Area of the given *Circle* :) But,

According

C I

C I

According to *Metius's* Proportion,

As 452 : 355 :: 510.76 : 401.15, the same as before.

But if you use *Archimedes's* Proportion, say,

As 14 : 11 :: 510.76 : 401.31; which Area is greater, than by the two former Proportions; tho' in small *Circles* this is near enough the Truth.

See Operation of all these.

22.6	As 1 : .7854 :: 510.76
22.6	.7854
1356	204304
452	255380
452	408608
510.76	357532
The Square of the Diameter.	
	401.150904 The Area.

By Scale and Compasses.

The Extent from 1 to 22.6 being twice turned over from .7854, will fall at last upon 401.15, the Area.

113	As 552 : 355 :: 510.76
4	355
452	255380
	255380
	153228
	452)181319.80(401.15
	1808
	519
	452
	678
	652
	2260
	2260
	

Q

As

C I

As 14 : 11 :: 510.76

11

510.76
51076

14) 561686(4020
56....

016

14

28

28

06

C I

PROBLEM V.

Having the Circumference of a Circle, to find the Area.

Because the Diameters of *Circles* are proportional to their Circumferences; that is, as the Diameter of one *Circle* is to its Circumference, so is the Diameter of another *Circle* to its Circumference.

Therefore the Area's of *Circles* are to one another, as the Squares of the Circumferences.

And if the Circumference of a *Circle* be 1, the Area of that *Circle* will be .07958; then the Square of 1 is 1, and the Square of 71 (the Circumference of the former *Circles*) is 5041; therefore it will be

Sq. Cir. Area. Sq. Circumf.

As 1 : .07958 :: 5041

5041

7958

31832

397900

401.16278 Area.

Or thus :

As 88 : 7 :: 5041

7

88) 35287(400.98 Area.

352

0870

704

76

Or as 1420 : 113 :: 5041 : 401.15.

PROBLEM

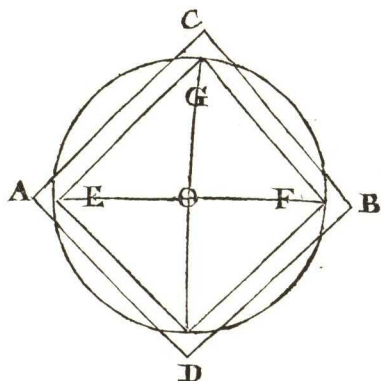
PROBLEM VI.

As 1 : 8862 :: 22.6, the Diameter.

By having the Diameter, to find the Side of a Square that is equal in Area to that Circle.

If the Diameter of a Circle be 1, the Side of a Square equal thereto will be 8862 : Therefore

$$\begin{array}{r}
 22.6 \\
 \hline
 53172 \\
 17724 \\
 17724 \\
 \hline
 20.02812
 \end{array}
 \quad \text{The Side of the Square AC.}$$



Let the Diameter of the Circle EF, or GH, be 22.6 (as before) to find the Side of the Square of the Side AC, AD, &c.

If .8862 be multiplied by 22.6, the Product will be 20.02812, which is the Side of a Square equal in Area to the Circle given; for if 20.02812 be multiplied

square-wise, that is, by itself, it will produce 401.1255907344; which is nearly equal to the Area found in the last Problem.

You may find the Side of the Square equal, by extracting the Square Root out of the Area of the given Circle.

$\overset{\circ}{4}01.\overset{\circ}{1}\overset{\circ}{5})20.0287295$ Side of the Square.
4

4002)01.1500

40048)349600
320384

29216

28034

1182

801

381

360

21

20

1

By this Method of extracting the Square Root of the Area, you may find the Side of a Square equal to any plain Figure, regular or irregular.

PROBLEM VII.

By having the Circumference, to find the Side of the Square equal.

If the Circumference of a Circle be 1, the Side of the Square equal will be .2821 : Therefore

As 1 : .2881 :: 71 The Circumf.

71

2821

19747

20.0291 The Side of the Square.

PROBLEM VIII.

Having the Diameter, to find the Side of a Square, which may be inscribed in that Circle.

If the Diameter of a Circle be 1, the Side of the Square in-

scribed will be .7071 : Therefore

As 1 : .7071 :: 22.6

226

42426

14142

14142

15.98046 The Side EG inscribed.

Or if you square the Semi-Diameter, and double that Square, the Square Root of the doubled Square will be the Side of the Square inscribed: For (by *Euclid* 1. 47.) the Square of the Hypothenuſe EG is equal to the Sum of the other two Legs EO and OG.

$$\begin{array}{r} 11.3 \\ 11.3 \\ \hline \end{array}$$

$$\begin{array}{r} 339 \\ 113 \\ 113 \\ \hline \end{array}$$

127.69 The Square of EO, which is double, because
 $EO = OG$.

255.38 (15.98 Root; which is the Side of the Square;
 1

$$\begin{array}{r} 25) 155 \\ 125 \\ \hline \end{array}$$

$$\begin{array}{r} 309) 3038 \\ 2781 \\ \hline \end{array}$$

$$\begin{array}{r} 3188) 25700 \\ 25504 \\ \hline \end{array}$$

$$\begin{array}{r} 196 \\ \hline \end{array}$$

PROBLEM IX.

Having the Circumference, to find the Side of a Square, which may be inscribed.

If the Circumference be 1, the Side of the Square inscribed will be .2251 : Therefore

As : 1 .2251 :: 71
 71

$$\begin{array}{r} 2251 \\ 15757 \\ \hline \end{array}$$

15.9821 The Side of the Square EG.

Because that in each of the four last Problems, viz. VIth, VIIth, VIIIth, and IXth, there is a Proportion laid down, it will be easy to work them by Scale and Compasses; for if you extend the

Compasses from the first to the second, that Extent will reach from the third to the fourth: As in the last Problem, where the Proportion is as 1 to .2251, so is 71 to the Side of the Square 15.9821.

Here extend the Compasses from 1 to .2251; that Extent will reach from 71 to 15.98; and so of the rest.

But the fifth must be wrought like the fourth, thus: Extend the Compasses from 1 to 71; and that Extent turn'd over the same Way from .07958, will fall at the last upon 401.15.

PROBLEM X.

Having the Area, to find the Diameter.

If the Area of a Circle be 1, the Square of the Diameter thereof is 1.2732: Therefore

Q 3

Area

Area. Sq. Diam. Area.

As 1 : 1.2732 :: 401.15

401.15

63660

12732

12732

50928

510.744180 (22.599 The Diameter.

4

42) 110

84

445) 2674

2225

4509) 44941

40581

45189) 436080

406701

29379

By Scale and Compasses.

Extend the Compasses from 1 to 1.2732; that Extent will reach from 401.15 to 510.74, &c.

Then divide the Space between 1 and 510.74 into two equal Parts, and you'll find the middle Point at 22.6.

Or you may divide the Space upon the Line of Numbers, between 401.55 and .7854 into two

equal Parts; and one of those Parts will reach from 1 to 22.6, the Diameter sought.

PROBLEM XI.

Having the Area, to find the Circumference.

If the Area of a Circle be 1, the Square of the Circumference will be 12.56637: Therefore

Area.

C I

C I

Area. Sq. Circumf. Area.
 As 1 : 1.256637 :: 401.15.
 401.15

6283185
 1256637
 1256637
 5026548

Circumf.
 5040.99932550 (70.9990 Root.
 49

109) 14099
 12681

14189) 141893
 127701

141989) 1419225
 1277901

14132450
 12779901

1352549

By Scale and Compasses.

Divide the Space between
 401.15 and .07958 upon the
 Line, into two Parts; one of
 those Parts will reach from 1 to
 71, the Circumference sought.

PROBLEM XII.

*Having the Area, to find the Side
 of a Square inscribed.*

If the Area of a Circle be 1,
 the Area of a Square inscribed
 within that Circle will be .6366 :
 Therefore

$$\text{As } 1 : 401.15 :: .6366$$

$$\begin{array}{r} 240690 \\ 240690 \\ 120345 \\ 240690 \end{array}$$

255.372090 (15.98 Roots ; which is the Side of the Square sought.

$$\begin{array}{r} 25) 155 \\ 125 \end{array}$$

$$\begin{array}{r} 309) 3037 \\ 2781 \end{array}$$

$$\begin{array}{r} 3188) 25620 \\ 25504 \end{array}$$

$$\begin{array}{r} 11690 \end{array}$$

The same Reason may be given for the last Proportion, that was given before for the Proportion of *Circles* to the Squares of their Diameters and Circumferences ; for not only the Squares of the Diameters and Circumferences are in Proportion to the Circles they belong to, but also Figures inscrib'd or circumscrib'd, have the Squares of their like Sides proportional to the *Circles* they are inscribed in, or circumscribed about, and also to the Figures themselves : The Square of any Side of one Figure, as the Square of the like Side of another similar Figure is to the Area thereof ; as may be found prov'd at large in *Euclid*, *Sturmius*, *Mathesis Emuleata*, and other Authors.

By Scale and Compasses.

Extend the Compasses from 1 to 401.15 ; that Extent will reach

from .6366 to 255.37 ; the halt Space between that and 1, is at 15.98, the Side of the Square.

PROBLEM XIII.

Having the Side of a Square, to find the Diameter of the circumscribing Circle.

If the Side of a Square be 1, the Diameter of a *Circle*, that will circumscribe that Square, will be 1.4142 : Therefore

$$\text{As } 1 : 1.4142 :: 15.98$$

$$\begin{array}{r} 113136 \\ 127278 \\ 70710 \\ 14142 \end{array}$$

22.598916 The Diameter sought.

By

By Scale and Compasses.

Extend the Compasses from 1 to 1.4142, and that Extent will reach from 15.98 to 22.6, the Diameter sought.

PROBLEM XIV.

Having the Side of a Square, to find the Diameter of a Circle equal.

If the Side of a Square be 1, the Diameter of a Circle, equal thereto, will be 1.128: Therefore

Side. Diam. Side of a Square.

As 1 : 1.128 :: 20.0291

1128

1602328

400582

200291

200291

22.5928248 Diamet.

By Scale and Compasses.

Extend the Compasses from 1 to 1.128, and that Extent will reach from 20.0291 (the Side of the Square given) to 22.6, the Diameter of the Circle sought.

PROBLEM XV.

Having the Side of a Square, to find the Circumference of the circumscribing Circle.

If the Side of a Square be 1, the Circumference of a Circle, that will encompass that Square, will be 4.443: Therefore

Side Sq. Circumf. Side Sq.

As 1 : 4.443 :: 15.98

15.98

35544

39987

22217

4443

70.99914 Circumference.

By Scale and Compasses.

Extend the Compasses from 1 to 4.443, and that Extent will reach from 15.98 to 71, the Circumference.

PROBLEM XVI.

Having the Side of a Square, to find the Circumference of a Circle that will be equal thereto.

If the Side of the Square be 1, the Circumference of a Circle that will be equal thereto, shall be 3.545: Then

As 1 : 3.545 :: 20.0291

3.545

1001455

801164

1001455

600873

71.0031595 Circumf.

By Scale and Compasses.

Extend the Compasses from 1 to 3.545, and that Extent will reach from 20.0291 to 71, the Circumference.

In

In several of the foregoing *Problems*, where the Diameter and Circumference is required, the Answers are not exactly the same as the Diameter and Circumference of the given *Circle*; but are sometimes too much, and sometimes too little, as in the two last *Problems*; where the Answers in each should be 71, the one being too much, and the other too little.

The Reason of this is, the final Defect that happens to be in the Decimal Fractions, they being sometimes too great, and sometimes too little; yet the Defect is so final, that it is needless to calculate them to more Exactness.

Every *Circle* is supposed to be divided into 360 Degrees.

The Area of a *Circle* is found by multiplying the Periphery by the fourth Part of the Diameter, or half the Periphery by half the Diameter.

The Area is also found by finding a fourth Proportional to 1000.785, and the Square of the Diameter; or to 452.355, and the Square of the Diameter.

Circles, and similar Figures inscribed in them, are always as the Squares of the Diameters: So that they are in a duplicate Ratio of their Diameters, and therefore of their Radii.

A *Circle* is equal to a Triangle, whose Base is equal to the Periphery, and its Altitude to the Radius; therefore *Circles* are in a Ratio compounded of the Peripheries and the Radii.

CIRCULAR, any Thing that is described or moved in a Round; as the Circumference of

a *Circle*, or the Surface of a Globe.

Circular Lines are such straight Lines as are divided from the Divisions made in the Arch of a *Circle*; as Sines, Tangents, Secants, &c.

Circular Numbers are such, whose Powers end in the Roots themselves; as 5, whose Square is 25, and Cube 125.

CIRCUMVOLUTIONS.

The Torus of the Spiral Line of the *Ionic* Volute.

CIRCUS, a large Building, either round or oval, used for the exhibiting Shews to the People.

The *Roman Circus* was a large Place or Square, arched at one End, encompassed with Porticoes, and furnished with Rows of Seats, placed ascending over each other.

CISTERN, is properly used for a subterraneous Reservoir of Rain-Water; or a Vessel made to serve as a Receptacle for Rain or other Water, for the necessary Uses of a Family.

If you would make your *Cisterns* under the House, as a Cellular, which is the best Way to preserve Water for culinary Uses; then lay the Brick or Stone with Terras, and it will keep Water very well.

Or you may make a Cement to join your Brick or Stone withal, with a Composition made of slacked sifted Lime and Linseed Oil, tempered together with Tow or Cotton-Wooll. The Bottom should be covered with Sand, to sweeten and preserve it.

Or you may lay a Bed of good Clay, and on that lay the Bricks for the Floor; then raise the Wall round about, leaving a convenient Space behind the Wall to ram in Clay, which may be done as fast as the Wall is raised: So that when it is finished, it will be a *Cistern* of Clay walled with Brick; and being in a Cellar, the Brick will keep the Clay moist, (although it shall sometimes be empty of Water,) that it will never crack.

Mr. *Worlidge* says, he has known this to hold Water perfectly in a shady Place, though not in a Cellar.

Thus in a Garden, or other Place, may such a *Cistern* be made, and covered over, the Rain-Water being conveyed thereto by declining Channels running to it. Also in or near Houses, may the Water that falls from them, be conducted thereto.

Authors speak of a *Cistern* at *Constantinople*, the Vaults of which are supported by two Rows of Pillars 212 in each Row, each Pillar being two Feet in Diameter. They are planted circularly, and in Radii tending to that in the Centre.

There are some Persons very scrupulous about these Waters, which are received in *Cisterns*; for they pretend that they are not all good, without Distinction; that Rain which falls in a small Quantity during Heats, and the great Rains which fall presently after great Droughts, are reckoned in the Number of those that are bad: And thence it is, they say, that the Water which is sometimes taken out of

Cisterns, has a very disagreeable Taste, and very often stinks. As for those Rains that fall during the Autumn, Spring and Winter, when the Weather is not violent; these, say they, will do. And in all fine Weather, they esteem the small Rains that fall in the Month of *May*, which should carefully be saved, to be the best, as being the purest and lightest, and even purify the Water they found in the *Cistern*.

As to the Way of making *Cisterns*, that is left to the Artift skilled that way; only it may be observed, the Walls should be good, and built to advantage, for fear the Water should be lost; that the Inside should be well cemented, especially in the Angles, without any Necessity of doing the same by the Arch or Roof, through which the Water cannot pass. As to the Bigness of the *Cistern*, that depends upon the Fancy of the Person.

The Manner of bringing together Rain-Water, is of Channels made of different Materials, fixed to the Edge of the Roofs of Houses, which convey the Water into a small Basin made of Lead or Tin, in the Midst of which, there is a Hole through which the Water passes into a Pipe that is there; and which, before it enters into the *Cistern*, helps it to fall into a Stone Trough made on purpose near the *Cistern*.

This Trough is placed to receive the Rain that falls from the Roofs of Houses, from whence it runs into the *Cistern*; but, as it has been observed before, that there is a Difference to be made between the Rains that

that fall, and which are received into these Conveyances, without Distinction, it is necessary you should know how to save those that are good and wholesome, and get rid of the rest; it must be by the Means of this Trough, which has a Hole in the Bottom, in a Cornér, on that Side where the most Declivity appears. This Hole must, at the Time you judge it convenient to save the Water, be stopped, to the End, that the Trough coming to be filled up to a certain Place, where there is a Grate on the Side of the *Cistern*, it may supply a Passage for the inclosed Water to fall into the *Cistern*; and when, on the contrary, they do not value the Rains that fall, they only leave that Hole open, so that so fast as the Water comes into the Trough, so fast it runs out.

There are those who do not use any such Trough as this, but suffer the Rain to fall without any Distinction into a subterraneous Place built higher than the *Cistern*, in which they put some River Sand, pretending that the Water which passes thro' is purged of all ill qualities it may have; and that consequently the Water they take out of these *Cisterns* to drink, ought to be extremely good.

CLAIR OBSCURE }
 CHIARO SCURO } in
 Painting, is the Art of distributing to Advantage the Lights and Shades of a Piece; both with Regard to the easing the Eye, and the Effect of the whole Piece.

Thus, when a Painter gives his Figures a strong Relievo,

loosens them from the Ground, and sets them free from each other by the Management of his Lights and Shades, he is said to understand the *Clair Obscure*.

The *Clair Obscure* makes one of the greatest Divisions, or Branches of Painting; the Whole of a Picture being resolvable into Light and Shadow.

The Doctrine of the *Clair Obscure*, may be brought under the following Rules:

Light may be considered either, 1st, in regard to itself; 2^{dly}, in regard to its Effects; 3^{dly}, in regard to the Place wherein it is diffused; 4^{thly}, in regard to its Use.

For the first Light is either natural or artificial.

Natural Light comes either immediately from the Sun, which is brisk, and its Colour various, according to the Time of the Day; or it is that of a clear Air, through which Light is spread, and whose Colour is a little bluish; or a cloudy Air, which is darker, yet represents Objects in their genuine Colours, with Ease to the Sight.

Artificial Light proceeds from Fire or Flame, and tinges the Object with its own Colour; but the Light it projects is very narrow, and confined.

For the second: The Effects of Light are either principal, as when the Rays fall perpendicularly on the Top of a Body, without any Interruption; or glancing, as when it slides along Bodies; or secondary, which is for Things at a distance.

3. For the Place: It is either the open Campaign, which makes Objects appear with great Softness;

ness; or an inclos'd Place, where the Brightness is more vivid, its Diminution more hasty, and its Extremes more abrupt.

4. For the Use or Application: The Light of the Sun is always to be suppos'd without, and over-against the Picture, that it may heighten the foremost Figures; the Luminaries themselves never appearing, because the best Colours, can't express them.

The chief Light to meet on the chief Group, and as much as possible, on the chief Figure of the Subject; the Light to be pursued over the great Parts, without being cross'd or interrupted with little Shadows.

The full Force of the principal Light to be only in one Part of the Piece; taking care never to make two contrary Lights: Not to be scrupulously confined to one universal Light, but to suppose other necessary ones; as the opening of Clouds, &c. to loosen some Things, and produce other agreeable Effects.

Lastly, The Light to be different, according to the Quality of Things whence it proceeds, and the Nature of the Subjects which receive it.

As for Shadows, they are distinguished,

1. Into those form'd on the Bodies themselves by their proper Relievo's.

2. Those made by adjacent Bodies; those that make Parts of any Whole; and the different Effects, according to the Difference of Places..

For the first: Since the different Effects of Lights only appear by Shadows, their Degrees must be well managed.

The Place which admits no Light, and where the Colours are lost, must be darker than any Part that has Relievo, and disposed in the Front.

The Reflex or Return of Light, brings with it a Colour borrowed from the Subject that reflects it; and flies off at a greater or less Angle, according to the Situation of the reflecting Body, with regard to the luminous one. Hence its Effects must be different in Colour, and in Force, according to the Disposition of Bodies.

Deepenings which admit not of any Light, or reflex, must never meet on the Relievo of any Member of any great elevated Part, but in the Cavities or Joints of Bodies, the Folds of Draperies, &c.

And to find Occasions for introducing great Shadows, to serve for the Repose of the Sight, and the loosening of Things, instead of many little Shadows, which have a pitiful Effect.

For the second: The Shadows made by Bodies, are either in plain or smooth Places, or on the Earth; wherein they are deeper than the Bodies that occasion them, as receiving less reflex Light; yet still diminish, as they depart further from their Cause, or on the neighbouring Bodies, where they are to follow the Form of the said Bodies, according to its Magnitude and its Position, with regard to the Light.

For the third: In Shadows that have Parts, the Painter must observe to take for a Light in a shadow'd Place, the Teint or Lustre of the light Part; and,

on the contrary, for the Shadow in the lightened Part, the Teint or Lustre in the Shadow : To make an agreeable Assemblage of Colour, Shadow and Reflex in the shadowed Part, but without interrupting the great Masses of Shadows; to avoid forming little Things in the Shadow, as not being perceiv'd, without closely look'd at; and to work, as it were, in the general, and at one Sight; never to set the strong Shadows against the Light, without softening the harsh Contrast, by the help of some intermediate Colour; though the Mass of Light may be placed either before or behind that of the Shadow, yet ought it to be so disposed, as to illumine the principal Parts of the Subject.

For the fourth : The Effects of Shadows are different, as the Place is either wide and spacious; as in those coming immediately from the Sun, which are very sensible, and their Extremes pretty abrupt; from the serene Air, which are fainter and more sweet; from the dark Air, which appear more diffused, and almost imperceptible; and those from an artificial Light, which makes the Shadows deep, and their Edges abrupt : Or as it is more narrow and confined, where the Light's coming from the same Place make the Shadow more strong, and the Reflex less sensible.

Clair-Obscure, or *Chiaro-Scuro*, is also used for a Design consisting only of two Colours, ordinarily black and white, sometimes black and yellow.

Or, it is a Design only wash'd with one Colour, the Shadows

being of a dusky brown Colour, and the Lights heightened up with white.

A CLAMP, is a kind of Kiln, built above Ground (of Bricks unburnt,) for the burning of Bricks.

These *Clamps* are built much after the Method that the Arches are built in Kilns, *viz.* with a Vacuity betwixt each Brick's Breadth, for the Fire to ascend by, but with this Difference, that instead of arching, they *truss over*, or *over-span*, as they term it, *i.e.* they lay the End of one Brick about half way over the End of another, and so till both Sides meet within half a Brick's Length, and then a binding Brick at the Top finishes the Arch.

The Mouth (at which the Fire is to be put in) is left open about two Feet and a half wide, and about three Feet in Height; and then they begin to truss over, which they do for three Bricks in Height; and which, with a binding Brick at the Top, will close up the Arch.

But after they have begun to make the Place to receive the Fuel (before it is closed at the Top,) they fill it almost full with Wood, and upon that, lay Sea-Coal; then it being over-spanned like an Arch, they strew Sea-Coal on all the Surfaces, and then lay another Course of Bricks the other Way, laying them at a little Distance from one another, and strowing Sea-Coal upon them : And thus they continue laying one Course one Way, and another the other, and strowing Sea-Coal betwixt each Course, 'till they come to eight or ten Feet high, according

C L

ing as the *Clamp* is to be for Big-
ness: When they have done this,
they set the Wood on Fire, and
that fires the Coals, which being
all burnt out, the whole *Clamp*
of Bricks is burnt.

CLAMP-NAILS, are such
Nails as are used to fasten on
Clamps in the building or repair-
ing of Ships.

CLAMPING, in Joinery, &c.
is when a Piece of Board, &c.
is fitted with the Grain to the
End of another Piece of Board
cross the Grain, the first Board
is said to be clamped. Thus the
Ends of Tables are commonly
clamped, to prevent them from
warping.

CLAY, a soft viscous Earth,
found in various Places, and used
for divers Purposes, of several
Kinds and Properties.

Dr. Lister, in the *Philosophical
Transactions*, gives a Catalogue
of twenty-two several *Clays*
found in the several Counties
of *England*; five of which he
calls *Pure*, i. e. such as are soft
like Butter to the Teeth, with
little or no Grittiness in them,
viz. Fullers Earth, which he dis-
tinguishes by its Colours, into
yellowish brown, and white.
2. Boles. 3. Pale-yellow *Clay*,
Cowshot *Clay*, Dark-blue *Clay*
or Marle.

Seventeen *Impure*; whereof
eight are harsh and dusty when
dry, as *Creta*, or Milk-white
Clay. Two Potters Pale-
yellow *Clay*. Potters Blue
Clay; Blue *Clay*, wherein the
Astroites is found; Yellow *Clay*,
and fine Red *Clay*. Soft Chal-
ky blue *Clay*; soft Chalky Red
Clay.

C L

Three are stony, when dry;
viz. a Red Stony *Clay*, a Blue
Stony *Clay*, and a White Stony
Clay.

Three are mix'd Sand, or
Pebbles, *viz.* one a Yellow
Loam, a Red Sandy *Clay*. Three
of a second Species of the same
Clay.

Lastly, Three are mix'd with
flat or thin Sand, glittering with
Mica, *viz.* one Crouch White
Clay. Two Grey, or Bluish To-
bacco-Pipe *Clays*. Three Red
Clays.

CLEAR [in Building] is
sometimes used by the Work-
men for the Inside Work of a
House.

CLEAVING of Laths, Pales,
Shingles, and Timber.

CLINKERS, those Bricks,
which having naturally much
Nitre, or Saltpetre in them, and
lying next the Fire in the Clamp
or Kiln, by the Violence of the
Fire, are run and glazed over.

CLOISTER, a Habitation
surrounded with Walls, and in-
habited by Canons, and the Re-
ligious.

In a more general Sense,
Cloister is used for a Monastery
of the Religious of either Sex;
where Friars, Monks, and Nuns,
live retir'd from the World. Al-
so a long Place covered with a
Floor or Plat-Fond, supported
by Pillars.

CLOSET, a general Name
for any very small Room. The
Contrivance of *Closets* in most
Rooms, now so much practised
in *England*, is one great Improve-
ment in Modern Architec-
ture.

COCHLEA,

COCHLEA, in Mechanicks, one of the five Mechanical Powers, otherwise called the Screw.

COCKLE-STAIRS. See **WINDING-STAIRS**.

COCK-PIT, a sort of Theatre, where Game-Cocks fight their Battles. It is commonly a House, or Hovel, cover'd over.

COENOTAPH, an empty Tomb or Monument, erected in Memory of Some illustrious Defunct, who perishing by Shipwreck, in Battle, &c. his Body could not be found to be interred or deposited in the same.

COINS. See **QUOINS**.

COLARIN, the little Frize of the Capital of the *Tuscan* and *Doric* Column, placed between the Astragal and the Annulets; called by *Vitruvius*, Hypotrachelium. Called also Cincture.

Colarin is also used for the Orlo or Ring on the Top of the Shaft of the Column next the Capital.

COLLAR-BEAM, a Beam fram'd cross betwixt two principal Rafters.

COLLEGE, a Place set apart for the Society and Cohabitation of Students.

COLLER. See **CINCTURE**.

COLONNADE, a Peristyle, of a circular Figure, or a Series of Columns disposed in a Circle, and insulated withinside. Such is that of the little Park at *Versailles*; which consists of thirty-two *Ionic* Columns, all of solid Marble, and without Incrustation.

A *Polystyle Colonnade* is that whose Number of Columns is

too great to be taken in by the Eye at a single View. Such is the *Colonnade* of the Palace at *St. Peter at Rome*, which consists of two hundred eighty-four Columns of the *Doric* Order, each above four Foot and a half Diameter, all in *Tiburtine* Marble.

COLUMN, a round Pillar, made to support or adorn a Building.

The *Column* is the principal or reigning Part of an Order.

The principal Laws and Properties of this eminent Member of Architecture, are thus deduced.

Every Fulcrum or Support is so much the more perfect, as it is the firmer, or carries the greater Appearance of Firmness. And hence all *Columns* or Pillars ought to have their Base or Foot broader than themselves.

Again, as a Cylinder, and a quadrangular Prism are more easily removed out of their Place than a truncated Cone or Pyramid, on the same Base, and of the same Altitude. The Figure of *Columns* ought not to be cylindrical, nor that of a Pilaster, pyramidal; but both the one and the other to be contracted or diminish'd, *i. e.* grow less and less like a truncated Cone, and a truncated Pyramid.

For the same Reasons, the lowest Parts of the *Columns* are to be cylindrical, and that of Pilasters, pyramidal. Hence, again, as *Columns* are more firm, if their Diameter bears greater Proportion to their Height, than if it bore a less, the greater Ratio is to be chosen where a large Weight,

Weight is to be sustain'd, and a less, where a less.

Further, as the Design of a *Column* is to support a Weight, it must never be suppos'd without an Entablature: Though a *Column* rais'd on an eminent Place, so as to leave no Room to fear its being thrust out of its Place, needs no Pedestal.

The entire *Column* in each Order is compos'd of three principal Parts; the Base, the Shaft, and the Capital.

Each of these Parts is again subdivided into a great Number of lesser, called Members or Mouldings: Some whereof are essential, and found in all *Columns*; others are only accidental, and found in all particular Orders.

Columns are made different, according to the several Orders they are used in; and likewise

not only with Regard to their Order, but also to the Matter, Construction, Form, Disposition, and Use.

COLUMNS, with Regard to Order.

Tuscan Column is the shortest and most simple of all the *Columns*.

Its Height, according to *Vitruvius*, *Palladio*, and *Vignola*, is seven Diameters or fourteen Modules; according to *Scamozzi*, fifteen Modules; to *De Lorme*, twelve Modules; to *Trajan's Column*, sixteen Modules.

Its Diminution, according to *Vitruvius*, is one Fourth of the Diameter; according to *Vignola*, a Fifth; and according to *Trajan's Column*, a Ninth.

The whole Height of this Column, and the Height of each principal Part thereof, according to several Authors, is as in the following Table.

O

	Whole Height	Pedest.	Base	Body	Capital	Archit.	Frieze	Cornic.
Auth. Nam.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.
<i>Vitr.</i>	II 5	2 20	0 30	6 0	0 30	0 30	0 30	0 30
<i>Vign.</i>	II 5	2 20	0 30	6 0	0 30	0 30	0 35	0 40
<i>Pall.</i>	IO 15	1 0	0 30	6 30	0 30	0 35	0 26	0 40
<i>Sc.</i>	II 15	1 52½	0 30	6 30	0 30	0 31½	0 41	0 41

The *Doric Column* is something more delicate: Its Shaft is adorn'd with Flutings. Its Height, according to *Vitruvius*, is from fourteen to fifteen Modules; to *Scamozzi*, seventeen; to *Vignola*, sixteen; in the *Coli-*

seum, nineteen; in the Theatre of *Marcellus*, fifteen two Thirds. Its Diminutions, according to the Theatre of *Marcellus*, twelve Minutes; to the *Coliseum*, four Minutes and a half.

The whole Height of this Column, and the Height of each principal Part thereof, according to several Authors, is as in the following Table.

Auth. Names	Whole Height	Pedest.	Base	Body	Capital	Archit.	Frieze	Cornic.
	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.
<i>Vitr.</i>	12 40	2 40	0 30	7 0	0 30	0 30	0 45	0 40
<i>Vign.</i>	12 40	2 40	0 30	7 0	0 30	0 30	0 45	0 45
<i>Pall.</i>	13 0	2 20	0 30	7 45	0 30	0 30	0 45	0 35
<i>Sca.</i>	12 58	2 26	0 30	7 30	0 30	0 35	0 45	0 42

The *Ionic Column* is more delicate still, it is distinguish'd from the rest by the Volutes in its Capital, and by its Base.

Its Height, according to *Palladio*, is seventeen Modules and

one Third; according to *Vignola*, eighteen.

Its Diminution, in the Temple of *Concord*, ten one half; of *Fortuna Virilis*, seven one half; of the *Coliseum*, ten Minutes.

The whole Height of this Column, and the Height of each principal Part thereof, according to several Authors, is as in this following Table.

Auth. Nam.	Whole Height	Pedest.	Base	Body	Capital	Archit.	Frieze	Cornic.
	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.	mo. mi.
<i>Vitr.</i>	14 15	3 0	0 30	8 10	0 20	0 37 $\frac{1}{2}$	0 30	0 52 $\frac{1}{2}$
<i>Vign.</i>	14 15	3 0	0 30	8 10	0 20	0 37 $\frac{1}{2}$	0 45	0 52 $\frac{1}{2}$
<i>Pall.</i>	13 28	2 40	0 52 $\frac{1}{2}$	7 40	0 27 $\frac{1}{2}$	0 34 $\frac{1}{2}$	0 27	0 46 $\frac{1}{2}$
<i>Sca.</i>	12 33 $\frac{3}{4}$	2 30	0 30	7 30	0 18 $\frac{3}{4}$	0 35	0 28	0 42

The *Corinthian Column* is the richest and most delicate of all the *Columns*.

Its Capital is adorn'd with two Rows of Leaves, and with Caulicoles, whence spring out little Volutes.

Its Height, according to *Vitruvius*, and many Remains of Porticoes, Temples, &c. is nineteen Modules; according to *Serlio*, eighteen; to the *Coliseum*,

Seventeen; to the three *Columns* in the *Campo Vaccino*, twenty; to the *Basilick of Antoninus*, twenty.

Its Diminutions, according to the Temple of *Peace*, six Minutes and a half; the *Pantheon*, six and a half; the Temples of *Sybil*, and *Fauslina*, eight; *Constantine's Arch*, seven; Porticoe of *Septimius*, seven and a half.

The whole Height of this Column, and the Height of each principal Part thereof, according to several Authors, is as in this following Table.

Auth. Nam.	Whole Height		Pedest.		Base		Body		Capital		Archit.		Frieze		Cornic.	
	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.
<i>Vitr.</i>	16	0	3	30	0	30	8	20	1	10	0	30	0	37 $\frac{1}{2}$	1	0
<i>Vign.</i>	16	0	3	30	0	30	8	20	1	10	0	45	0	45	1	0
<i>Pall.</i>	13	54	2	30	0	30	7	55	1	5	0	36	0	28	0	50
<i>Scal.</i>	14	42 $\frac{1}{2}$	2	30	0	30	8	5	1	10	0	39	0	31 $\frac{3}{4}$	0	46 $\frac{3}{4}$

The *Composite Column* has two Rows of Leaves in its Capital, like the *Corinthian*; and angular Volutes, like the *Ionic*.

Its Height, according to *Vignola*, and *Titus's Arch*, is twenty Modules; to *Scammozzi*, and the Temple of *Bacchus*, nineteen

and a half; to *Septimius's Arch*, 19.09.

Its Diminution, according to *Titus's*, and *Septimius's Arch*, seven Minutes; to the Baths of *Dioclesian*, eleven and one Third; to the Temple of *Bacchus*, sixty and a half.

The whole Height of this Column, and the Height of each principal Part, according to the several Authors, is, as in this following Table.

Auth. Nam.	Whole Height		Pedest.		Base		Body		Capital		Archit.		Frieze		Cornic	
	mo.	mi.	mo.	mi.	mo.	mi.	no.	mi.	mo.	mi.	mo.	mi.	mo.	mi.	mo.	mi.
<i>Vitr.</i>	16	6 $\frac{1}{2}$	3	30	0	30	8	20	1	10	0	52 $\frac{1}{2}$	0	52 $\frac{1}{2}$	0	52 $\frac{1}{2}$
<i>Vign.</i>	16	0	3	30	0	30	8	20	1	10	0	45	0	45	1	0
<i>Pall.</i>	15	20	3	20	0	30	8	25	1	5	0	45	0	30	0	45
<i>Scal.</i>	15	20	3	20	0	30	8	25	1	5	0	40	0	32	0	48

It may be here observed, that there seems to be more of Caprice, than Reason, in that Diversity found in the Heights of Columns of the same Order in different Authors; each of which frequently takes the Liberty of dispensing with his own Rules.

As for Instance, *Vitruvius* makes the *Doric Columns* of Temples shorter than those of Porches behind Theatres: *Palladio* gives a greater Height to Columns standing on Pedestals, than to those which have none: And *Serlio* makes his Column a Third shorter, when insulate or detached, than when contiguous to the Wall.

But not withstanding the Diversity of Height in the Columns of the same Order, in different Authors, they still bear a true Proportion in the several Orders compar'd with each other; by which they go increasing, as the Orders are less massive.

But this Augmentation is greater in some Ordonnances than

in others; for in the Antique, it is but five Modules, or Semi-diameters, for the Five Orders; the shortest Column, viz. the *Tuscan*, being fifteen Modules; and the longest the *Composite*, twenty.

In *Vitruvius*, this Increase is also of five Modules, but commences from fourteen Modules, and ends at nineteen.

The Moderns usually make it greater: *Scamozzi* makes it five Modules and a half: *Palladio*, and *Serlio*, six.

From the several Proportions of Columns assign'd by several Authors. *M. Perrault* has formed a new one, which is a Mean betwixt the Extreams of the rest.

Thus he makes the *Tuscan Column* fourteen Modules and two Thirds; which is a Mean between the *Tuscan* of *Vitruvius*, fourteen; and that of *Trajan's Column*, eighteen.

The Height of the *Doric Column* he makes sixteen Modules, which is a Mean between the fourteen

fourteen of *Vitruvius*, and the nineteen of the *Coliseum*.

He makes the *Ionic* in Height seventeen Modules one Third; which is a Mean between the sixteen of *Serlio*, and the nineteen of the *Coliseum*.

He makes the Height of the *Corinthian Column* eighteen Modules two Thirds, as being a Medium between the sixteen Modules six Minutes of the Temple of the *Sybil*, and the twenty Modules six Minutes of the three Columns of the *Roman Forum*.

Lastly, he, by the same Rule, makes the *Composite Column* twenty Modules, that Height being a Mean between *Titus's Arch*, and the Temple of *Bacchus*.

Indeed, the Rule he goes by, seems very rational, viz. the progressional Advance of each *Column* in the different Orders, be equal; so that having settled the whole Progression from the *Tuscan* to the *Composite*, at five Modules ten Minutes: This being a Mean between the Modules of the *Antique* and the five one half of the *Moderns*; he divides this Sum, which is a hundred and sixty Minutes, into four equal Parts, giving forty Minutes to the Progression of each Order: This makes the *Tuscan Column* fourteen Modules twenty Minutes. The *Doric* becomes sixteen; the *Ionic* seventeen, ten Minutes; the *Corinthian*, eighteen, twenty Min. and the *Composite*, twenty Mod.

The Method of Drawing a Column.

EXAMPLE.

To draw the Base of a Column, by which the Nature of describing any other Part may be known, the Rule being the same.

Let the Base *ABCDEFGK* be given to be described in Profile.

1. Let *LN* be the Diameter of the *Column* given, divided into sixty Minutes as aforesaid.

2. Draw a Right Line at Pleasure, as *wk*; and in the Midst of that, raise the Perpendicular *KL*, which let represent the Central Line of the *Column*.

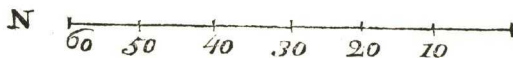
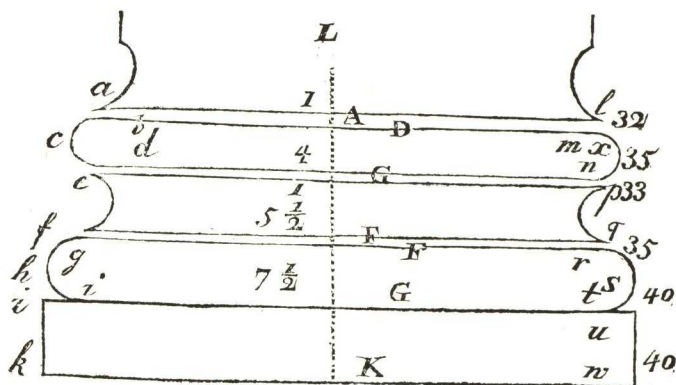
3. Take from your Module ten Minutes, and set it on the Central Line from *K* to *G*; also take seven Minutes and a half, and set it from *G* to *F*; also take one Minute, and set it from *F*

to *E*; and so in like manner, the Distance *ED* five half Minutes; the Distance *DC* one Minute; the Distance *GB* five Minutes; and the Distance *BA* one Minute.

4. Through all these several Points, draw Right Lines parallel to the Base *wk*.

5. Make *Kk*, *Kw*, *Gi*, and *Gv* each = 40 Minutes, and join *vw* and *ik*, and so will the Plinth be completed.

6. Make *Fr*, *Fg*, *Eq*, and *Ef*, each = 35 Minutes, and join *qr* and *fg*, so will the lower be completed; and if from the



said Fillet, you describe Semi-circles *rst*, and *ghi*, they will compleat the lower Torus.

Lastly, Proceed to set off the other Fillets *ndpe*, and *lmab*, with the upper Torus *mbnd*, and Scotia *pegf*, the whole Base will be compleated, as required.

Thus may the Base of any Order be easily delineated by the Proportions fixed thereto; and in the same Manner, you may likewise compleat an entire Order.

Note, That the Diameter of the *Column* at the Base, being divided into sixty equal Parts, is called a *Module*; and the equal Parts are called *Minutes*; by which, the Heights and Projectures of every Member are set off from the Central Line of the *Column*.

There are some Occasions, wherein an Architect cannot give his Building a sufficient Projecture, patricularly where the

Entablement would hinder the Sight of the Windows above, or intercept the Sight of the Apartments below.

In these Cases, the *Columns* are to have one third Part of their Diameter inserted or let into the Wall behind them.

But Recourse should never be had to this Shift, excepting in Cases of Necessity; for the *Columns* here, lose an infinite deal of that Beauty and Grace which they have when they stand alone.

It frequently happens too, that the *Columns* are let within the Wall, for the greater Solidity, and the further Strengthening of the Building.

This, however, ought to be observ'd, that they never lose above one Third of their Diameter; the Reason of which will appear in the Article *IMPOSTS*.

When

When the *Columns* stand alone, they have usually a *Pilaster* placed behind them, joined to the Wall, or the *Pillar* of the *Porticoe*.

Sometimes, instead of a *Pilaster*, we have a *Column* let within the Wall, in order to make the Symmetry more compleat.

Though we allow of a *Column* let within the *Pillar* of the *Porticoe*, yet we can never approve of the letting a *Column* within a *Pilaster*.

Of Diminishing.

Columns of every Order must

be so form'd, that the upper Part of the Body be less than the lower.

Which Diminishing must be more or less, according to the Proportion of their Heights; and is to be begun from one third Part of the whole Shaft upwards, (*i.e.* the lower third Part is to be of an equal Bigness) which *Philander* prescribes by his own precise measuring of antient *Columns*,) as the most graceful Diminution. And as to the Quantity to be diminish'd, Architects lay down the following Rule:

That the $\left\{ \begin{array}{l} \textit{Tuscan} \\ \textit{Doric} \\ \textit{Ionic} \\ \textit{Corinthian} \\ \textit{Composite} \end{array} \right\}$ *Column* be $\left\{ \begin{array}{l} \frac{1}{4} \\ \frac{1}{3} \\ \frac{1}{2} \\ \frac{1}{6} \\ \frac{1}{7} \\ \frac{1}{8} \end{array} \right\}$ Part

smaller at the Top just under the Capital, than below just above the Base, *i.e.* the Diameter of

The Top of the $\left\{ \begin{array}{l} \textit{Tuscan} \\ \textit{Doric} \\ \textit{Ionic} \\ \textit{Corinthian} \\ \textit{Composite} \end{array} \right\}$ *Column* is $\left\{ \begin{array}{l} \frac{3}{4} \\ \frac{1}{2} \\ \frac{1}{3} \\ \frac{1}{4} \\ \frac{1}{5} \\ \frac{1}{6} \\ \frac{1}{7} \\ \frac{1}{8} \end{array} \right\}$

of the Diameter of the *Column* below.

COLOURS, in Painting, is used both as to the Drugs themselves, and to those Tints produced by those Drugs variously mix'd and apply'd.

The principal Colours used by Painters, are Red and White Lead, or Ceruse, Yellow and Red Ogres: Several Kinds of Earth, as Umber, Orpiment, Black Lead, Cinnabar, or Vermilion, Gumbouge, Blue and Green Ashes, Indigo, Bistre,

Lamp-Black, Smalt, Ultramarine, and Carmine.

Of these Colours, some are ground in Oil, others only in Fresco, and others in Water, and others for Miniature.

Painters reduce all Colours under these two Classes of Dark and Light Colours. Under Dark Colours, are comprehended Black, and all those which are obscure and earthy, as Umber, Bister, &c. And under Light Colours,

are comprehended White, and all those which approach nearest to it.

COMMENSURABLE QUANTITIES, in Geometry, are such as have some common Aliquot Part, or which may be measured by some common Measure, so as to leave no Remainder in either. Thus a Foot and a Yard are *Commensurables*, there being a third Quantity which will measure both, *viz.* an Inch, which taken twelve Times, makes a Foot, and thirty-six Times, a Yard.

Incommensurable is otherwise. The Ratio of *Commensurables* is rational; that of *Incommensurables* is irrational.

Commensurable Numbers, whether Integers, or Fractions, are such as have some other Number which will measure or divide them without any Remainder: Thus 6 and $8\frac{1}{2}$ are respectively by *Commensurable Numbers*.

COMMISSURE, in Architecture, &c. the Joint of two Stones; or the Application of the one to that of the other.

COMMON, in Geometry, is apply'd to an Angle, Line, or the like, which belongs equally to two Figures, or makes a necessary Part of both.

COMMON DIVISOR, in Arithmetick, is a Quantity or Number which exactly divides two or more other Quantities or Numbers, without leaving any Remainder.

COMPARTITION, in Architecture, signifies the useful and graceful Disposition of the whole Ground-Plot of an Edi-

fice into Rooms of Office and Reception or Entertainment.

COMPARTIMENT, } a De-
COMPARTIMENT, } sign
composed of several different Figures, disposed with Symmetry, to adorn a Platfond, Parterre, Panes of Glass, or Pannels of Joinery, the Squares of a Ceiling, &c.

A *Compartment* of Tiles is an Arrangement of white and red Tiles varnish'd for the Decoration of the Covering of a Roof.

COMPASSES, or } is
A Pair of **COMPASSES** } a
Mathematical Instrument used for the describing of Circles, measuring the Distances of Points, Lines, &c.

The common *Compasses* consist of two Branches or Legs of Iron, Brass, or other Metal, pointed at Bottom, and at the Top joined by a Rivet, whereon they move as on a Centre

Hair-Compasses are so contrived on the Inside, as to take an Extent to a Hair's Breadth.

German Compasses are those whose Legs are a little bent outwards towards the Top; so that when shut, only the Points meet.

Spring-Compasses, or *Dividers*, are made of harden'd Steel, the Head arch'd, which, by its Spring, opens the *Compasses*, the Opening being directed by a circular Screw, fastened to one Leg, and let through the other work'd with a Nut.

Turn-up-Compasses, a late Contrivance to save the Trouble of changing the Points.

Compasses of three Branches. Their Use is to take three Points at once, and so to form Triangles, &c.

Trisecting Compasses. Whose Use is for trisecting of Angles Geometrically.

Cylindriack Compasses.

Proportional Compasses.

Beam Compasses consist of a long Branch or Beam carrying two Brass Cursors; the one fixed at one End, the other sliding along the Beam, with a Screw to fasten it, on Occasion: To the Cursors may be skrew'd Points of any kind, whether Steel for Pencils, or the like. It is used to draw large Circles, take great Extents, &c.

Elliptical Compasses. Their Use is to draw *Ellipses* or *Ovals* of any kind.

COMPLEMENT, in Geometry, is what remains of a Quadrant of a Circle, or of ninety Degrees, after a certain Arch has been retrenched from it. Thus if an Arch or Angle be twenty-five Degrees, they say, its Complement is sixty-five, since 65 and 25 , Σ 90 .

COMPOSITE ORDER, in Architecture, is the last of the five Orders of Columns, so called, because its Capital is composed out of those of the other Columns.

It borrows a Quarter-Round from the *Tuscan* and *Doric*; a Row of Leaves from the *Corinthian*; and Volutes from the *Ionic*. Its Cornice has simple Modillions or Dentils.

The *Composite* is also called the *Roman*, or *Italick Order*, as having been invented by the Ro-

mans, conformably to the rest which are denominated from the People, among whom they had their Rise.

This by most Authors is ranked after the *Corinthian*, either as being the richest, or the last that was invented. *Scamozzi* alone places it between the *Ionic* and *Corinthian*, out of Regard to its Delicacy and Richness, which he esteems inferior to that of the *Corinthian*, and therefore makes no Scruple to place it under it. In which he is follow'd by *M. Le Clerc*.

The Proportions of this Order are not fixed by *Vitruvius*; he only marks the general Character of it, by observing that its Capital is composed of several Parts taken from the *Doric*, *Ionic*, and *Corinthian*.

He does not seem to look upon it as a particular Order, nor does he vary it at all from the *Corinthian*, except in its Capital.

In Fact, it was *Serlio*, who first added the *Composite* Order to the Four of *Vitruvius*, forming it from the Remains of the Temple of *Bacchus*, the Arches of *Titus*, *Septimius*, and the *Goldsmiths*: Till that Time, this Order was esteem'd a Species of the *Corinthian*, only differing in its Capital.

This Order being thus left undetermin'd by the Antients, the Moderns have a kind of a Right to differ about its Proportions, &c.

Scamozzi, and after him, *M. Le Clerc*, makes its Column nineteen Modules and a half; which is less by half a Module, than that of the *Corinthian*, as in Effect,

fect, the Order is less delicate than the *Corinthian*.

Vignola makes it twenty, which is the same with that of his *Corinthian*. But *Serlio*, who first formed it into an Order, by giving it a proper Entablature and Base, and, after him, *M. Perrault*, raise it still higher than the *Corinthian*.

This last does not think different Ornaments and Characters sufficient to constitute a different Order, unless it have a different Height too. Therefore conformably to his Rule of augmenting the Heights of the several Columns by a Series of two Modules in each, he makes the *Composite* twenty Modules, and the *Corinthian* eighteen; which, it seems, is a Medium between the Porch of *Titus* and the Temple of *Bacchus*.

M. Perrault, in his *Vitruvius*, makes a Distinction between the *Composite*, and *Composed* Order.

The latter, he says, is any Composition whose Parts and Ornaments are extraordinary and unusual; but have withal somewhat of Beauty, both on Account of their Novelty, and in respect to the Manner or Genius of the Architect: So that a Composed Order is an arbitrary humorous Composition, whether regular or irregular.

He likewise adds, That the *Corinthian* Order is the first *Composite* Order, as being compos'd of the *Doric* and *Ionic*, as *Vitruvius* himself observes.

The COMPOSITE ORDER, by Equal Parts.

The Height of the Pedestal being three Diameters and one Third, is divided into four, giving one to the Base, whose Plinth is two Thirds thereof: The other Part is divided into ten; three for the Torus, one for the Astragal, one half Part for the Fillet, three and a half for the Cymase, one and a half for the Astragal, one half Part for the Fillet which finishes to the Naked with a Hollow; the Breadth of the Naked is a Diameter and two Fifths.

The Projection is equal to its Height; the upper Astragal hath three of these Parts, and the lower Astragal eight.

The Height of the Cornice is half the Base, being one Eighth of the whole Height, and is divided into twelve Parts, giving a half Part to the Fillet, one and a half to the Astragal, three and a half to the Cymase, a half Part to the Fillet, three to the Corona, two to the Ogee, and one to the Fillet.

For the Projections, the Astragal hath two and a half of these Parts, the Fillet six, the Corona seven, and the Whole, nine.

The Base of the Column.

Make use of the same Base as in the *Corinthian* Order; though the Attic Base in the *Doric*, may
very

very properly be made use of, for this, and also for the *Ionic*, and *Corinthian* Orders, especially in Work exposed to the Weather: Therefore instead of placing it here again, is shewn the Plane of either of the Capitals as mentioned in the *Corinthian* Order.

The Diminishing of this Column is the same as the last.

The Height of the Capital is a Diameter and one Sixth; and being divided, give two to each Height of Leaves whose Heads turn down a half Part, two Thirds of a Part to the Space between the Leaves and Fillet, one Third to the Astragal and Fillet, which is one Third of that, two Thirds to the Ovolo, one Third to the Space between the Ovolo and Abacus, a half Part to the Hollow, and a half Part to the Ovolo, whose Fillet hath one Third thereof.

The Projection is the same as the *Corinthian*.

The Height of the Entablature being two Diameters, is divided into six; giving two to the Architrave, one and a half to the Frieze, and two and a half to the Cornice.

The Height of the Architrave is divided into nine, giving two and a half to the first Face, a half Part to the Ogee, three and a half to the second,

one Fourth to the Astragal, three Fourths to the Ovolo, one to the Hollow, and a half Part to the Fillet.

The Projection of the second Face hath half a Part, the Ovolo one and one Fourth, and the Whole, two.

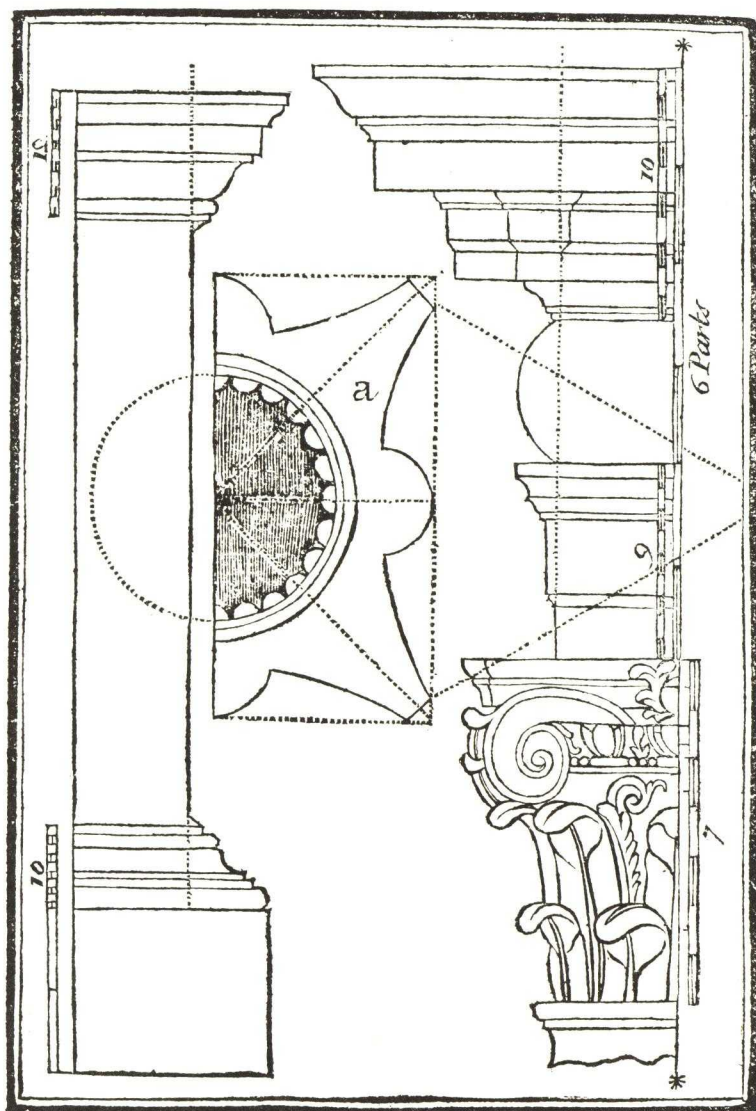
The Frieze is form'd after the same Method as the *Ionic*, being Part of a Circle that answers to the Naked, and Projection of the Architrave.

The Cornice is divided into ten Parts, giving one Fourth of a Part to the Fillet, as much to the Astragal; one Part to the Ogee, another to the first Face of the Modillions, a half Part to the Ogee, one and one Fourth to the second Face, one Fourth to the Fillet, a half Part to the Ovolo, two to the Corona, three Fourths to the Cima Reversa, one Fourth to the Fillet, one and a half to the Cima Recta, and a half Part to the Fillet.

For the Projections, the Ogee hath one and half of these Parts, the upper Face of the Modillions in Front two, but is two and half in Breadth, *viz.* a half Part within the Naked, the Cap thereof a half Part, the Return'd Modillion four and a half, and its Cap 5, the Corona seven and a half, the Cima Reversa eight and a half, and the Whole ten being equal to the Height.

CO

CO



COMPOSITION, in Painting, includes the Invention and Disposition of the Figures, the Choice of Attitudes, &c.

Therefore *Composition* consists of two Parts; of which the one finds out by the Means of History, proper Objects for a Picture; and the other disposes them to Advantage.

Composition of Proportion signifies the comparing of the Sums of the Antecedent and Consequent; with the Consequent in two equal Ratio's: As suppose 4:8:3:6, by *Composition* of Proportion, we say 12 is to 8, as 9 is to 6.

Composition of Motion, in Mechanicks, is an Assemblage of several Directions of Motion, resulting from Powers acting in different, though not opposite Lines.

If a Point more or less, flow according to one and the same Direction, whether that be equable or not, yet it will still keep the same Right Line; the Celerity alone being changed, *i. e.* increased or diminish'd, according to the Forces with which it is impelled.

If the Directions be opposite, as one *e. gr.* directly downwards, the other upward, &c. yet still the Line of Motion will be the same.

But if the compounding Motion be not according to the same Line of Direction, the compound Motion will not be according to the Line of Direction of either of them, but a different one from them both; and this, either straight, or crooked, according as the Directions or Celerities shall require.

If two compounding Motions be each of them equable, the Line of the compound Motion will still be a straight Line: And this, though the Motions be neither at right Angles one to another, nor equally swift, nor each to itself equable, provided they be but similar, that is, *both accelerated and retarded alike.*

COMPRESSION, the Act of pressing or squeezing something together, so as to set its Parts nearer to each other, and make it possess less Space.

To **CONCAMERATE**. To make an arched Roof, as in Vaults, &c. To arch over.

CONCAVE, is said to be the inner Surface of a hollow Body, especially if it be circular.

Concave is particularly understood of Mirrors and Lenses.

Concave Lenses are either *concave* on both Sides, called *Concavo-concave*, or *concave* on one Side, and plain on the other, called *Plano-concave*, or *concave* on the one Side, and *convex* on the other, called *concavo-convex*, or *convex-concave*, as the one or the other Surface is a Portion of the less Sphere.

The Properties of all *concave* Lenses are, that the Rays of Light, in passing through them; are deflected, or made to recede from one another; as in convex Glasses, they are inflected towards each other, and that the more, as the *Concavity*, or *Convexity*, are Portions of less Circles.

Hence parallel Rays, as those of the Sun, which by passing thro' a *concave* Lens, become diverging: Diverging Rays are made to diverge

diverge the more, and converging Rays, either made to converge less, or become parallel, or go out diverging.

Hence Objects view'd through *concave* Lenses, appear diminished; and the more so, as they are Portions of less Spheres: And this, in oblique, as well as in direct Rays.

Concave Mirrors have the contrary Effect to Lenses: They reflect the Rays which fall on them, so as to make them approach more to, or recede less from each other, than before; and that the more, as the *Concavity* is greater, or the Spheres, of which they are Segments, less.

Hence *concave* Mirrors magnify Objects presented to them; and that, in a greater Proportion of greater Spheres.

CONCENTRICK, that which has the same common Centre with another. The Word is principally used in speaking of round Bodies, and Figures, *viz.* Circular and Elliptical ones, &c. But may be used likewise in Polygons, drawn parallel to each other upon the same Centre.

CONCLAVE, in Architecture, is a Closet or inner Chamber.

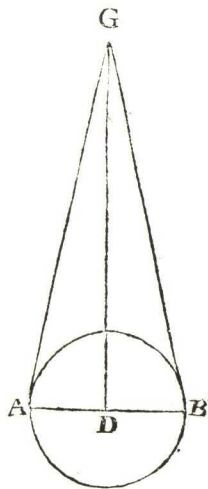
CONDENSER, in Pneumatics, is a Machine or Engine whereby an unusual Quantity of Air may be crowded into a given Space.

They can throw in three, four, five, or ten Atmospheres into the *Condenser*, *i. e.* three, four, &c. Times as much Air as there is in the same Compass without the Engine.

CONDUCTS, γ Suits or **CONDUITS**, $\S$ Gutters, to convey away the Suillage of an House. Also Canals or Pipes for the Conveyance of Water or other fluid Matter.

Sir *Henry Wotton* says, that in the first Place, Art should imitate Nature, in separating those ignoble Conveyances from the Sight; and (where a Running Water is wanting,) they should be placed in the most remote, and lowest Part of the Foundation, with secret Vents passing up through the Walls (like a Tunnel) to the wide Air: Which all *Italian* Artists commend for the Discharge of noisome Vapours.

A **CONE**, is a Solid, having a circular Base, and growing smaller and smaller, 'till it ends in a Point, which is called the Vertex, and may be nearly represented by a Sugar-Loaf.



The RULE to find out its Solidity.

Multiply the Area of the Base by a third Part of the perpendicular Height, and the Product is the solid Content.

Let ABC be the *Cone*, the Diameter of whose Base AB is

26.5 Inches; and the Height of the *Cone* DC is 15.5 Feet.

First, Square the Diameter 26.5, and it will make 702.25, which multiply by 7854, and the Product will be 551.54715; which being multiply'd by 5.5, the Product will be 3033.407825; which being divided by 144, the Quotient will be .2107 *ferè*, the solid Content of the *Cone*.

The Operation.

$$\begin{array}{r} 144)3033.503(21.07 \text{ Feet} \\ \underline{353} \text{ Content} \\ 947 \end{array}$$

$$\begin{array}{r} 26.5 \text{ the Diameter} \\ 26.5 \\ \hline 1325 \\ 1590 \\ 530 \\ \hline 702.25 \text{ Square} \\ 7854 \\ \hline 280900 \\ 351125 \\ 651800 \\ 491575 \\ \hline 551.54715 \text{ Area of Base} \\ 55 \frac{1}{3} \text{ Pt. of the Height} \\ \hline 275773 \\ 275773 \\ \hline 3033503 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 13.54 to 26.5. (the Diameter) that extend, turn'd twice over from 5.5 (a third Part of the Height) will at last fall upon 21.07 Feet the Content.

To find the Superficial Content.

Multiply half the Circumfe-

rence 41.626 by the slant Height AC 198.46, and the Product will be 8261.09596; which being divided by 144, the Quotient is 57.37 *ferè* the Curve Surface; to which add the Base, and the Sum will be 61.2 Base, the Superficial Content.

C O

$$\begin{array}{r}
 41.626 \\
 198.46 \\
 \hline
 249756 \\
 166504 \\
 333008 \\
 374634 \\
 41626 \\
 \hline
 8261.09596
 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 144 to 198.46; and that Extent will reach from 41.626 to 57.37 Feet, the Curve Surface.

Then extend the Compasses from 12 to 26.5 (the Diameter) and that Extent turn'd twice over from 7854 will at last fall upon 3.83 Feet, the Base; which being added to 57.37, the Sum will be 61.2 Feet, the Superficial Content.

DEMONSTRATION.

Every *Cone* is the third Part of a Cylinder of equal Base and Altitude.

The Truth of this may easily be conceived, by only considering that a *Cone* is but a round Pyramid; and therefore it must needs have the same Ratio to its circumscribing Cylinder, as the square Pyramid hath to its circumscribing Parallelopipedon, viz. as 1 to 3. However, to make it the clearer, let it be consider'd, That

Every right *Cone* is constituted of an infinite Series of Circles, whose Diameters do continual-

C O

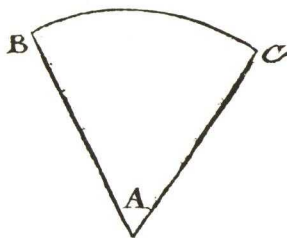
$$\begin{array}{r}
 144) 8261.09596 (57.37 \text{ Feet } fere \\
 \hline
 1061 \\
 530 \\
 989 \\
 \hline
 144) 551.54 (3.83 \\
 \hline
 1195 \\
 434 \\
 \hline
 2
 \end{array}$$

61.20 Whole
(Cont.)

ly increase, in Arithmetical Progression, beginning at the Vertex or Point C, the Area of its Base AB being the greatest Term; and its perpendicular Height DC, the Number of all Terms; therefore the Area of the Circle of the Base multiply'd by a third Part of the Altitude DC, will be the Sum of all the Series, equal to the Solidity of the *Cone*.

The Curve Superficies of every Right *Cone* is equal to half the Rectangle of the Circumference of its Base into the Length of its Side.

For the Curve Surface of every Right *Cone* is equal to the Sector of a Circle, whose Arch BC



is equal to the Periphery of the Base of the *Cone*, and the Radius AB equal to the slant Side of the *Cone*.

Which

Which will appear very evident, if you cut a Piece of Paper in the Form of a Sector of a Circle ABC, and bend both the Sides AB and AC together till they meet, and you will find it to form a Right *Cone*.

CONGE [in Architecture, a Moulding, either in Form of a Quarter-Round, or a Cavetto, which serves to separate two Members from one another.

Such is that which joins the Shaft of the Column to the Cincture, called also *Apophyge*, which in *Greek*, signifies Flight, the Column seeming to arise. Hence, by the *Latins*, it is called *Scapus*, the Shaft of the Column.

CONGES, are Rings or Ferriils, heretofore used in the Extremities of Wooden Pillars, to keep them from splitting, afterwards imitated in Stone-Work.

CONICK SECTION, a curve Line arising from the Section of a Cone.

CONICKS, that Part of the Higher Geometry, or Geometry of Curves, which considers the *Cone*, and the several Curve Lines arising from the Sections.

CONOIDES, } in Geometry,
CONOID, } a solid Body resembling a Cone, -except in this, that instead of a perfect Circle for its Base it has an Ellipsis, or some other Curve approaching thereto.

CONSECTARY is a Proposition that follows, or is deduced from some preceding Definitions, Lemmata, Axioms, or the like; whence some chuse rather to call it a Consequence, and others a Corollary.

VOL. I.

CONSOLE [of *consolider*, *Fr.* to re-unite, join, &c.] is an Ornament cut upon the Key of an Arch, which has a Projection or Jetting, and on Occasion serves to support little Cornices, Figures, Busts, and Vases.

These are also upon Occasion called Mutules, Modillions, &c. according to their Form: Some of them are striated, or fluted; others in Form of Cartouches; others have Drops, in the Manner of Triglyphs.

Those made at the End of a Plank of Wood, cut Triangularwise, are called Ancones.

Consoles are frequently used as Keys of Arches, projecting out to support a Vase, or other Ornament.

M. *Le Clerc* is of Opinion, that a *Console* should always have something exceedingly massive, to sustain and serve it as a Rest.

CONSPIRING POWERS, in Mechanicks, are all such as act in Directions not opposite to one another.

CONTACT, the relative State of two Things that touch each other, or whose Surfaces join to each other without any Interstice.

Hence because very few Surfaces are capable of touching in all Points, and the Cohesion of Bodies is in Proportion to their *Contacts*, those Bodies will stick fastest together, which are capable of the most *Contact*.

CONTENT, the Capacity or Area of a Space, or the Quality of any Matter of Space included in certain Bounds.

S

The

The *Content* of a Ton of round Timber is forty-three solid Feet. A Load of hewn Timber contains fifty Cubick Feet. In a Foot of Timber are contained seventeen hundred and twenty-eight cubick or square Inches; and as often as seventeen hundred and twenty-eight Inches are contained in a Piece of Timber, be it round or square, so many Foot of Timber are contained in the Piece.

CONTIGNATION, in the antient Architecture, the Art of laying Rafters (in *Latin, Tigna*) together, and particularly Flooring.

CONTIGUOUS, signifies that two or more Things are disposed so near each other, as they join their Surfaces, or touch.

Contiguous Angles, in Geometry, such as have one Leg common to each Angle, otherwise called Adjoining Angles, in Contradiction to those produced by continuing their Legs through the Point of Contact; which are called Opposite or Vertical Angles.

CONTOUR, the Out-Line, or that which terminates or defines a Figure. In Architecture, it is the Out-Line of any Member, as that of a Base, a Cornice, or the like.

CONTRACTILE Force, in Mechanicks, is that Power or Property inherent in certain Bodies, whereby, when extended, they are enabled to draw themselves up again to their former Dimensions.

CONTRAMURE, in Architecture, an Out-Wall built about the Wall of a City.

TO CONTRAST, in Architecture, is to avoid the Repetition of the same Thing, in order to please by Variety; as is done in the Great Gallery in the *Louvre*, where the Pediments are alternately arched and angular.

CONTRAST, in Painting, and Sculpture, signifies an Opposition or Difference of Position, Attitude, &c. of two or more Figures, contriv'd to make Variety in Painting: Thus in a Group of three Figures, when one is shewn before, another behind, and a third sideways, there is said to be a *Contrast*.

The *Contrast* is not only to be observ'd in the Position of several Figures, but also in that of the several Members of the same Figure: Thus if the Right Arm advance the farthest, the Right Leg is to be hindmost: If the Eye be directed one Way, the Right Arm is to go the contrary Way.

Nay, the *Contrast* is to be persu'd even in the Drapery.

CONVERGING Lines, }
CONVERGENT Lines, } in Geometry, are those which approximate, or whose Distance becomes continually less and less. These are opposed to divergent Lines, whose Distance becomes continually greater. Lines which converge one Way diverge another.

Converging Rays, in Dioptricks, are those Rays, which in their Passage out of one Medium into another, of a different Density, are refracted towards one another, so as if far enough continued, they will meet in a Point or Focus.

Thus

Thus all Convex Lenses make the Rays *converge*, and Concave ones make them *diverge*, *i. e.* the one inflects them towards a Centre, and the other deflects them from it; and the more, as such Lenses are Portions of smaller Spheres.

On which Properties, all the Effects of Lenses, Microscopes, Telescopes, &c. depend.

Rays coming *converging* out of a denser Medium into a rarer, *v. g.* from a Glass, into Air, become more *convergent*, and concur sooner, than if they were to continue their Motion through the first.

Rays coming *converging* out of a rarer into a denser Medium, *converge* less, and concur later, than if they had continu'd their Motion through the first.

Parallel Rays passing from a denser, into a rarer Medium, *v. g.* from Glass into Air, will become *convergent*, and concur in a Focus.

Converging Series, in the Mathematics, is a Method of Approximation, or coming still nearer and nearer towards the true Root of any Number or Equation; even though it be impossible to find any such true Roots in Numbers.

CONVERSE, in Geometry, &c. A Proposition is said to be the *Converse* of another, when, after drawing a Conclusion from something first supposed, we proceed to suppose what had been before concluded, and to draw from it what had been supposed. As for Example;

Thus 'tis demonstrated in Geometry, that if the two Sides of a Triangle be equal, the two

Angles opposite to these Sides are equal also: The *Converse* of the Proposition is, that if the two Angles of a Triangle be equal, the two Sides opposite to these Angles are equal also.

CONVEXITY is the exterior Surface of a *Convex*, *i. e.* a gibbous and globular Thing, in Opposition to Concavity or the inner Surface, which is hollow or depress'd.

A *Convex Lens* is either *convex* on both Sides, called a *Convexo-Convex*, or it is plain on one Side, and *convex* on the other, called a *Convexo-Concave*, or *Concavo-Convex*, as the one or the other Surface prevails, *i. e.* as this or that is a smaller Portion of a Sphere.

All *Convex Lenses* inflect the Rays of Light in their Passage, *i. e.* send them out from their *convex* Surface, converging so as that they concur in a Point or Focus.

Hence all *Convex Lenses* magnify, *i. e.* represent their Images larger than their Objects; and this the more, as they are Portions of smaller Spheres.

A *Convex Mirror* represents the Images smaller than the Objects, as a Concave one represents them larger: A *Convex Mirror* reflects the Rays from it; diverging; and therefore disperses and weakens their Effect, as a *Convex* one reflects them converging, so as to concur in a Point, and have their Effect increas'd; and by how much the Mirror is the Portion of a smaller Sphere, by so much does it diminish the Objects, and disperse the Rays the more.

COPING of a *Wall*, the Top or Cover of a Wall, made sloping, to carry off the Wet.

Coping over, in Carpentry, a sort of Hanging over, not square to its Upright, but bevelling on its Underfide till it end in an Edge,

The Price: Brick-Walls (of a Brick and half thick) have been cop'd with Stone for 4*d.* a Foot, lineal or running Measure, the Workman drawing the Stones, into this Price.

Drawing of Stones for *Coping*: A Penny a Foot has been given for drawing them, for this Use.

CORBEILS [of the *Latin Corbis* a Basket] is a Piece of Carved Work in the Form of a Basket, full of Flowers or Fruits, serving in Architecture to finish some Ornament.

CORBELS, in Architecture, the Representation of a Basket sometimes seen on the Heads of the Caryatides.

Sometimes *Corbel* is used to signify the Vase or Tambour of the *Corinthian* Column, so called on Account of the Resemblance it bears to a Basket; or because it was first form'd on the Model of a Basket.

CORBIL, ζ is also used in **CORBEL**, ς Building, for a short Piece of Timber, placed in a Wall with its End sticking out six or eight Inches, as Occasion serves, in the Manner of a Shouldering-Piece.

The under Part of the End thus sticking out, is sometimes cut in the Form of a Boulton, sometimes of an Ogee, and sometimes of a Face, &c. according as the Workman's Fancy is, the upper Side being plain and flat.

These *Corbels* are usually placed for Strength, immediately under the Semi-Girders of a Platform, and sometimes under the Ends of Camber-Beams: In which latter Case, they are usually placed a Foot or two below the Beam, and have a Piece of Timber standing upright close to the Wall from the *Corbel* to the Beam.

Corbel is also used by some Architects, for the hollow Niches or Hollows left in the Walls for Images, Figures, or Statues to stand in.

CORINTHIAN ORDER, the fourth, or, as *Scamozzi* and *M. Le Clerc* make it, the fifth and last of the Orders of Architecture; being the noblest, richest, and most delicate of all others.

The Invention of this Order is ascrib'd to *Callimachus*, an *Athenian* Sculptor, by most of the Moderns, after *Vitruvius*, who passing by the Tomb of a certain young Lady, over which her Nurse had placed a Basket with some of her Play-Things, and cover'd it up from the Wet with a Tile, the Whole having been placed on a Root of *Acanthus*, as it sprung up, the Branches encompass'd the Basket, and bending down at the Top under the Corners of the Tiles, form'd a Sort of Volutes.

Hence *Callimachus* took his Hint: The Basket he imitated in the Base of his Column, the Leaves in the Volutes, and the Tile in the Abacus of this Order.

The *Corinthian Order* has several Characters by which it is distinguish'd from the rest. Its Capital is adorn'd with two Rows

Rows of Leaves, between which arise little Stalks or Caulicoles, of which the Volutes are formed, which support the Abacus, and are in Number sixteen.

It has no Ovolo, nor even Abacus, properly speaking; for the Member which goes by that Name, is quite different from the Abacus of the other Orders, being cut with a Sweep, in the Middle of which is carved a Rose, or other Ornament.

Vitruvius observes that the *Corinthian* Order has no particular Ordinance for its Cornice, or any of the other Ornaments of its Entablature; nor does he give it any other Proportions, than those of the *Ionic* Order: So that if it appears higher than the *Ionic*, 'tis purely owing to the Excess of the Height of its Capital.

He also makes the rest of the Entablature the same, and also uses the *Attic* Base indifferently for the one and the other.

But *Vitruvius* differs widely in this Order from all the Examples of Antiquity now remaining: The most beautiful of which have a particular Base, and the whole Order twenty Modules high; whereas the *Ionic* has but eighteen.

Again, its Capital is higher than that of *Vitruvius* by one Third of a Module; and its Entablature, which has Modillions, and sometimes Dentils together with the Modillions, is very different from the *Ionic* Entablature.

Most modern Architects pass by *Vitruvius's* *Corinthian* Ordinance, and follow that of the ancient Buildings; and select

from them according to their several Tastes. So that the modern *Corinthian* is a kind of *Composite*, differing from many of the antient Buildings, and much more from *Vitruvius*.

Vignola and *M. Le Clerc* made the *Corinthian* Order twenty Modules in Height; yet *Serlio* makes it but eighteen; and *M. Perrault*, eighteen two Thirds, retrenching something from the nineteen of *Vitruvius*.

M. Perrault makes the Height of the Shaft less than that of the *Ionic*, by reason of the Excess of its Capital.

The Corinthian Column by equal Parts.

Corinthian Pedestal, being in Height three Diameters, and is divided into four, allowing one to the Base, whose Plinth is two Thirds of it: The other Part is divided into nine, allowing two and a half to the Torus, a half Part to the Fillet, three to the Cymase, a half Part to the Fillet, and two and a half to the Ogee; and the Breadth of the Die is a Diameter, and two Thirds.

The *Projection of its Base* is equal to its Height, the upper Fillet has three of these Parts, and the lower Fillet seven. The Height of the Cornice is half the Base being one Eighth of the whole Height; and is divided into eleven, by allowing one and a half to the Ogee, a half Part to the Fillet, three to the Cymase, three to the Corona, two to the Ogee, and one to Fillet. The Projection of the Fillet has two of these Parts, the Cymase four and a half, the

Corona six and a half, and the Whole eight and a half.

The Height of the *Base of the Column* is half a Diameter, which is divided into six, allowing three Fourths to the Plinth, one to the lower Torus, one Fourth to the Fillet, a half Part to the Scotia, one to the Astragals and Fillets (which are to be parted into six, allowing one to each Fillet, and two to each Astragal,) a half Part to the Scotia, one Fourth to the Fillet, and the other three Fourths to the Torus; the Fillet above the said Torus, is equal to the others, and Part of the Column.

The Projection is one Fifth of the Diameter; and the upper Fillet has one of the said six Parts, the upper Torus, and the lesser Fillets have one and a half, and one three Fourths are allowed to the Astragals, and lower Fillet.

Diminishing of this Column is one Eighth of the Diameter.

The *Corinthian Capital*. Divide the Diameter into six Parts, and take seven such Parts for the Height, allowing two to each Height of the Leaves (whose Heads turn down half a Part of it) allow another Part of the Stalks whose Heads turn down one Third of it; three Fourths to the small Volutes, and one Fourth to the Fillet; the large Volute is as high as the said Fillet; a half Part to the Hollow, and a half Part to the Ovolo, whose Fillet has one Third of it.

For the *Projection of the Capital*, make a Square, each Side

being a Diameter and half, and draw the Diagonals (See the *COMPOSITE Order*), and towards each Angle, mark a Diameter from the Centre, and draw the Cants at Right Angles with the said Diagonals: Then, for the Curvature of the Abacus, make an equilateral Triangle, (the Part of the Square cut off by the Cants being the Base,) and the opposite Angle the Centre. In the Circumference of the Column are eight Leaves, each Leaf having four Plants, and each Plant five Raffles. The Projection of their Heads is found by a straight Line from the Abacus to the Colarino. The Rose is high as the Volute, and projects to the Side of the before-mentioned Square.

The *Architrave* is divided into nine Parts, allowing one and a half to the first Face, one and one Fourth to the small Bead, two to the second Face, three Fourths to the small Ogee, two and half to the third Face, a half Part to the Bead, one to the Ogee, and a half Part to the Fillet.

The *Projection* of the second Face has one Fourth of a Part, the third Face, one of those Parts, and the Whole, two.

The Height of the *Entablature* is two Diameters, and is divided into six Parts, two of which go to the Architrave, one and a half to the Frize, and two and a half to the Cornice.

The *Cornice* is divided into twelve Parts, allowing one and one Fourth to the Ogee, one Fourth

Fourth to the Fillet, one and one Fourth to the Dentils, one Fourth to the Fillet, one Fourth to the Ovolo, one Fourth to the Fillet, two to the Modillions, a half Part to the Ogee, and one Fourth to the Fillet; one and three Fourths to the Corona, three Fourths to the Cima Reverfa, one Fourth to the Fillet, one and a half to the Cima Recta, and a half Part to the Fillet.

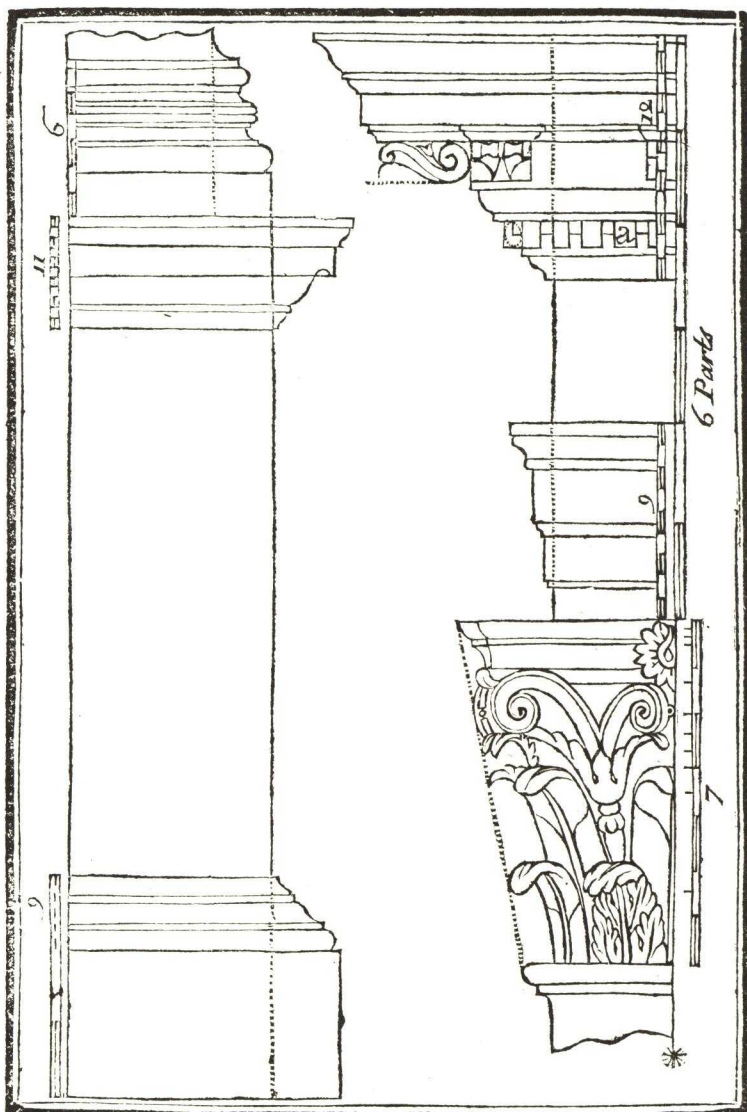
As for the *Projections* of the *Cornice*: The Ogee is one half of these Parts, and the Dentils

two and a half. The Dentils are in Breadth two Thirds of their Height, and the Spaces two Thirds of their Breadth.

The *Modillions* project three and three Fourths; and its Breadth is one Fifth of the Diameter; and one being in the Centre, gives the Spaces. The return'd Modillions eight and a half, the Cap nine, the Corona nine and a half, the Cima Reverfa ten and a half, and the Whole twelve, being equal to the Height. See the Figure,

C O

C O



CORK, a Tree like the Holm Tree, resembling the same in its Leaves, Catkins, and Fruit, the Bark of it is light, spongy, and of a grey Colour, inclining to Yellow.

There are indeed several Sorts of this Tree; but two more remarkable, *viz.* One of a narrower, less jagged Leaf, and perennial; the other of a broader Leaf, and falling in the Winter.

It grows in the coldest Part of *Biscay*, in the North of *England*, in *Italy*, *Provence*, and South-west Parts of *France*, especially the second Species, which are the fittest for our climate.

It grows in all sorts of Ground, dry Heath, stoney and rocky Mountains, so that its Roots run above the Earth, where they have little to cover them; and therefore we have no reason to despair of their growing with us.

There were none of them in *France* in *Pliny's* Time; but there are large Woods of them in *Italy*, from whence it is probable they were transplanted hither.

The Manner of decorticating or taking off the Bark of the *Cork-Tree*, is as follows: They once in two or three Years strip it in a dry Season, otherwise the intercaneous Branches endanger the Tree, and therefore a rainy Season is very pernicious to them when the Bark is off; they unwrap it before the Fire, and press it even, and that with Weights, on the convex Part, and so it continues, being cold.

The best Bark should be light, even; of a middling Thickness, without Cracks, having a few Knobs, and easy to be cut.

There are Cups made of one sort of *Cork*, good for heetical persons to drink out of.

The *Egyptians* made Coffins of *Cork*, which being lined with a resinous Composition, preserved their Dead uncorrupted.

They sometimes in *Spain* line their Stone Walls with it, which renders them very warm, and corrects the Moisture of the Air.

Beneath the *Cork*, or Bark of this Tree, there are two other Coats; one of them reddish, which they strip from the Bole when fell'd, and is valued by Turners; the rest of the Wood is not only good Firing, but also applicable to many other Uses in Building.

CORNER Stones, are two Stones commonly of *Rigate* or *Fire-Stone*; of which there stands one in each Jaumb of a Chimney. Their Faces are hollow in Breadth, being a certain Sweep of a Circle. The Breadth of each Stone is equal to the Breadth of the Jaumb; and their Height reaches from the Hearth to the Mantletree.

As to the Price: These Stones have been bought in *London* for 20*s.* per Pair.

CORNICE } [The Word
CORNICHE } is formed from the *Latin*, *Coronis* a Crowning] is the uppermost Member of the Entablature of a Column, or that which crowns the Order.

The *Cornice* is the third grand Division of the Trabeation commencing with the Frieze, and ending with the Cymatium.

The *Cornice* is different in the different Orders, there being as many

many Kinds of *Cornices*, as there are different Orders of Columns.

It is most plain in the *Tuscan* Order.

Vignola makes it to consist of an Ovum or Quarter-Round, an Astragal or Baguette, the Reglet or Fillet, the Larmier, and the Talon.

In the *Ionic*, the Members are in most Respects the same as in the *Doric*; except that they are frequently enriched with Carving, and have always Dentils.

In the *Doric*, *Vignola* makes the Capitals of the Triglyphs of the Frieze, with their Bandelettes, a Talon, Mutules, or Dentils; a Larmier, with its Guttæ underneath, a Talon, Fillet, Cavetto, and Reglet.

The *Corinthian Cornice* is the richest, and is distinguished by having both Modillions and Dentils, contrary to the Opinion of *Vitruvius*, who looks upon these two Ornaments as incompatible; and of M. *Le Clerc*, who accounts the Dentils as peculiar to the *Ionic*.

In the *Composite* there are Dentils, its Mouldings carved, and there are Channels under the Soffit.

The *Tuscan*, according to *Vitruvius*, the whole Height of this *Cornice* is one Module and a half; which Height being divided into four grand Divisions, the uppermost of which goes to the Boultin and Fillet under it; and this Division being subdivided into four Parts, three of them go to the Boultin, and one to the Fillet.

The two next grand Divisions go to the Corona, or Crown, (which is flat and plain,) and the lowermost grand Division goes

to the Cymatium; which being again divided into three Parts, the uppermost of them goes to the Fillet, and the other two to the Cyma or Ogee.

The Projecture of the whole *Cornice*, as also of each Member thereof, he makes to be equal to its Height; and the under Side of the Corona he divides into 11 Parts, of which he allots two to the Fillet, and one to the Denticle, and so alternately; for, says he, it is fitting to have three as deep as they are large.

Scamozzi makes the whole Height of this *Cornice* 39 Minutes, and the Height of each particular Member of it (beginning at the Top, and descending orderly) is as follows: The upper List or Plinth of the *Cornice*, three M. the Supercilium, List, Tinea, or Eye-Brow, one M. and a half; the upper Cima or Ogee eight M. the List under it one Minute and a half; the Corona or Crown $9\frac{3}{4}$ M. the List 1 M. $\frac{1}{2}$; the Cima or greater Ogee, six M. (here is one and a half M. left betwixt for the Depth of the Dentils;) the Supercilium or List one and a half M. the Cymatium or little Ogee five M. the List, two M.

Palladio makes the whole Height of this *Cornice* forty-four M. of which the List at the Top is three and a half M. the *Scima Recta* ten M. the List under it two and a half M. the Corona ten M. the Boultin nine, the List one and a half, and the Cavetto or Hollow seven and a half M.

The *Doric Cornice* is made by *Vitruvius* after two different Fashions; the whole Height of the

one is half a Module, which being divided into two grand Divisions, one of them (*viz.* the upper one) is subdivided into eight Parts, of which one Part goes to the List at Top, and the other seven to the Ogee.

The other grand Division is again divided into four Parts, the uppermost and lowermost of which Parts go to the two Cymatiums, and the two middle Parts go to the Corona.

The List of each of these Cymatiums, is one Third of the whole Cymatium.

The whole Height of the other fashioned *Cornice* is forty M. which being divided into nine Parts, two are to go to the two Fascia's, one to the Thorus or Boultin above them, two to the Modillions above that, two to the Crown, and two to the Cima or Ogee at the Top.

The Modillions, as also the Crown, being divided each into three Parts, one of them shall go to their respective Cymatiums, of which their Lists are each one Third of the Whole.

Scamozzi makes the whole Height of this *Cornice* forty-two M. of which the List at the Top is two M. the great Ogee seven M. the List one M. the little Ogee three M. the Corona eight M. the List one M. the Casement two M. the Boultin five M. the List one M. the Square seven M. the List one M. and the Boultin four M.

Palladio, in his verbal Description of this *Cornice*, makes the whole Height of it to be thirty-five M. But in his Figure it is but thirty-three M. and a quarter, of which the List at

Top is two M. and a quarter, the *Cima Recta*, or Ogee, six M. three Fourths; the List one M. the *Cima Reverfa* three M. one Fourth; the Corona eight M. the Ovolo or Boultin six M. the List one M. and the Casement at the Bottom five M.

The *Ionic*: *Vitruvius* makes the whole Height of this *Cornice* about fifty-two M. and a half. He describes two *Cornices* of different Fashions in this Order; in one of which he divides the whole Height into eleven Parts; the two uppermost of which go to the Cymatium, and the Boultin under it: And this Space is again subdivided into six Parts; two of which go to the Fillet of the Cymatium, three to the Ogee, and one to the Boultin.

The next two grand Divisions go to the Corona; and the next three to the Cartouses, and the Cymatium over them: And this Space being subdivided into five Parts, one of them makes the Cymatium, of which the Fillet is one Third of the Whole; then one and a half of the next grand Division goes to the Boultin and Fillet over it, of which the Fillet is one seventh Part of the Whole. And again, one and a half of the next grand Division goes to the Casement and Fillet over it, of which the Fillet is one Fourth of the Whole.

And the last grand Division goes to the Cymatium, of which the Fillet is one third Part of the Whole.

In the *Cornice* of the other Fashion, he divides the whole Height into six Parts; the uppermost of which he allows to the Ogee,

Ogee, the Fillet of which is one sixth Part; the next grand Division being subdivided into three Parts, the uppermost of them goes to the Cymatium, (the Fillet of which is one third Part,) and the other two to the Corona.

The next two grand Divisions are subdivided into five Parts; the uppermost of which goes to the Cymatium (the Fillet of which is one third Part,) and the other four to the Cartouches.

The next grand Division is subdivided into four Parts; three of which go to the Boultin, and one to the Fillet under it.

And the last grand Divisions being subdivided into four Parts, three of them are for the Casement, and one for the Cymatium, of which its Fillet is one third Part.

According to *Scamozzi*, the whole Height of this *Cornice* is forty-two M. whereof the Lift at the Top is two M. the Cima Recta five and a half M. the Lift one M. the Cima Reversa two and a half M. the Corona six and a half M. the Cima Reversa two and a half M. the Cartouches seven M. the Boultin four M. the Lift one M. the Square five M. the Lift one M. and the Boultin four M.

According to *Palladio*, the whole Height of this *Cornice* is forty-six and a half M. of which the Lift at the Top is two and a half M. the Cima Recta seven M. the Lift one and one Fourth M. the Cima Reversa three and a half M. the Corona eight M. the Cima Recta over the Modillions three and one Fourth M.

the Modillions seven and a half M. the Lift one M. the Ovolo or Boultin six M. the Lift one and one half, and the Cavetto or Hollow five M.

The whole Height of the *Corinthian Cornice*, according to *Vitruvius*, is about one Mod. And he describes two Forms of *Cornices*, in this Order: In one of which, he divides the whole Height into five Parts; the uppermost of which goes to the Ogee, of which its Fillet is one sixth Part.

Then one and one Fourth goes to the Corona and Cymatium over it, of which Space the Cymatium is one third Part, and its Fillet one Third of that.

Then one and three Fourths of the next grand Divisions go to the Modillions and Cymatium over them, of which Space, the Cymatium is one seventh Part.

And the last grand Division goes to the Boultin and Fillets over and under it; and this being divided into three Parts, the lowermost goes to the Fillet; and the other two being subdivided into six Parts, five of them go to the Boultin, and the other to the Fillet over it.

In the *Cornice* of the other Fashion, the whole Height is divided into nine Parts; of which the two uppermost being divided into four Parts, three of them go to the Ogee, (whose Fillet is one Sixth of the Whole,) and the other to the Cymatium over the Corona, (whose Fillet is one Third of the Whole,) and the next two grand Divisions go to Corona.

The next two grand Divisions go to the Modillions, and the Cymatium over them: One Fourth of this Space goes to the Cymatium (whose Fillet is one Third of the whole Cymatium) and the rest of the Modillions.

The next two grand Divisions go to the Boulton, and the Fillet over and under it, which Fillets are each one Seventh of the Whole. And

The last grand Division goes to the Cima at the Foot of the Cornice.

Scamozzi makes the whole Height of this Cornice forty-six and three Fourths M. of which the Lift of the Cima Recta is two M. the Cima Recta six and a half M. the Lift of the Cima Reversa one M. the Cima Reversa three and one Fourth M. the Half Round one and one half M. the Corona seven and one half M. the Cymatium three and one half M. the Modillions eight and a half M. the Lift one M. the Boulton five M. the Lift one M. and the Cima five M.

Palladio makes the whole Height of this Cornice fifty M. of which two and one Third M. go to the Lift of the Cima Recta; the Cima Recta is eight and one Third M. the Lift two Thirds M. the Cima Reversa three M. the Corona seven one Third M. the Lift of the Ogee over the Modillions two Thirds M. the Ogee 2 and two Thirds M. the Modillions eight and a half M. the Boulton four and one Third M. the Lift one M. the Boulton five and a half M. the Lift one M. and Ogee four and a half M.

The *Composite Cornice*: *Vitruvius* makes the whole Height of it equal to the Diameter of the Column above, which is about fifty-two and a half M.

He also describes two Cornices of this Order of a different Fashion; one of which he divides into two Parts, the uppermost of which goes to the Ogee (whose Fillet is one Seventh of the Whole,) and the undermost to the Corona and Cymatium over it; and this Space being divided into four Parts, three of them go the Corona, and one to the Cymatium, whose Fillet is one Third of the whole Cymatium.

Scamozzi makes the whole Height of this Cornice forty-eight M. and *Palladio* forty-five M. but for the Height of each particular Member, they leave us very much in the Dark.

Goldman makes the Height of the *Tuscan Cornice* one and one Third, and its Projecture two and two Fifths M. the Height of the *Doric* one and one Third, and its Projecture two and two Fifths. The Height of the *Ionic* one and three Fifths; its Projecture two and two Fifths. The Height of the *Composite* one and three Fifths; its Projecture two and thirteen Thirties. The Height of the *Corinthian* one and two Fifths; its Projecture two and thirteen Thirties.

The Projecture of the CORNICE.

'Tis an established Rule in Architecture, that the Cornice of the Entablement have its Projecture nearly equal to its Height:

Height; and yet the Projecture may may be safely made a little larger on Occasion, particularly where a beautiful Profile is required.

Cornice is used in general for all little Projectures of Masonry or Joinery, even where there are no Columns, as the *Cornice* of a Chimney, a Buffet, &c.

Architrave Cornice is one that is immediately contiguous to the Architrave, the Frieze being retrenched.

Mutilated Cornice is one whose Projecture is cut or interrupted to the Right of the Larmier, or reduced into a Platband with a Cymase.

Cantaliver Cornice, a Term used by Workmen for a *Cornice* that has Cantalivers underneath.

Coving Cornice, a *Cornice* which has a great Casement or Hollow in it, ordinarily lathed and plaistered upon Compass-Sprechets, or Brackets.

Modillion Cornice, a *Cornice* with Modillions under it.

Cornice is also used for the Crownings of Pedestals.

The *Cornice*, too, is different in the different Orders: In the *Tuscan*, according to M. *Perreault*, it has a Platband, which serves as a Corona and a Cavetto with its Fillet.

In the *Doric*, it has a Cavetto with a Fillet, which bears with a Drip crown'd with a Square.

In the *Ionic*, a Cavetto with its Fillet above, and a Drip, or hanging Square, crown'd with an Ogee, and its Fillet.

In the *Corinthian*, an Ogee with its Fillet, a Cymatium under the Ogee; Corona, and an Ogee with its Fillet.

Lastly, In the *Composite*, a Fillet with the Sweep over the Die, an Astragal, a Cima with its Fillet, Corona, and Ogee with its Fillet.

The Price: Mr. *Leybourn* tells us, some *Cornices* are valued by the Piece, dearer or cheaper, according to their Largeness, Goodness of the Stuff, and Curiosity of the Workmanship: Others are measured and rated by the Foot, running Measure, *i. e.* by the Number of Feet in Length only.

Some say, the common Rate for making of *Plain Cornices* (without any Carving) under the Eaves of a House, they commonly have 1s. per Foot running Measure.

Mr. *Wing* says, that *Cornices* are valued according to their Nature and Bigness. A *Modillion Cornice* of Freestone, of eighteen or twenty Inches thick, is worth 5d. or 6d. a Foot running Measure. And as to Joiners Work, a *Modillion Cornice*, with its carved Work, is worth 7s. a Foot, and a plain *Modillion Cornice* of twelve or fourteen Inches, will be worth 3s. 6d. or 4s. a Yard running Measure.

Some Workmen say a *Brick Cornice* is worth 2s. 6d. per Foot.

CORONA, } in Archi-
CORONES, } tecture, is
CROWN, } a large
CROWNING, } flat strong
Member of the *Cornice*, so called, because it crowns not only the *Cornice*, but the Entablature, and the whole Order.

The *French* call it the *Larmier*, our Workmen the Drip,

as serving, by its great Projecture, to skreen the rest of the Building from the Rain.

Some call it absolutely the *Cornice*, as being the principal Member thereof *Vitruvius* frequently uses the Word *Corona* for the whole Cornice.

The *Corona* is itself crown'd or finish'd with a Riglet or Fillet.

The *Corona*, M. *Le Clerc* says, is that large square Moulding immediately under the Cymase.

It projects very much, both for the greater Beauty of the Entablature, and for the better sheltering even of the whole Order.

He also says, he makes this Part stronger than the Cymase, as being the ruling Member of the Entablature, and even of the Order.

Underneath this he usually digs a Channel, for three Reasons; the first is to give it more Grace and Ornament; the second is to render it less heavy; and the third is to prevent Rain, or other Moisture, from trickling down along the Order.

For the Water falling from the Top of the Cornice, not being able to ascend into the Channel, is forced to fall Drop-by-drop on the Ground, by the Means of a little Ledge; and 'tis on this Account, that the Bottom of the *Corona* is called *Larmier*, or Drip.

CORNUCOPIA, in Architecture, Sculpture, &c. or Horn of Plenty, is represented under the Figure of a large Horn, out of which issue Fruits, Flowers, &c.

CORRIDOR, in Architecture, a Gallery, or long Isle,

around a Building, leading to several Chambers, at a Distance from each other.

CORSA. This Word, as *Fascia* and *Tænia*, in *Vitruvius*, signifies what is by us called Platband.

COUCH, in Painting, is used for each Lay or Impression of Colour, whether in Oil, or in Water, wherewith the Painter covers the Wall, Wainscot, or other Matter to be painted.

So they say, a Painting has had its last *Couch*, or Lay. A Ceiling has had two *Couches*.

The Word *Couch* is also used for a Lay or Impression on any Thing, to make it more firm and consistent, and to skreen it from the Weather; as Painting is cover'd with a *Couch* of Varnish.

COVING, in Building, when Houses are built projecting over the Ground-Plot, and the turn'd Projecture arch'd with Timber, (turn'd with a Quadrant of a Circle or Semi-Arch,) lathed and plaistered, under which People may walk dry, (as is much used at *Tunbridge-Wells*) on the Upper Walks,) the Work is commonly called *Coving*.

Mr. *Wing* says, that the Carpenters Work of *Coving* is worth 4s. per Square.

COUNTER Drawing, in Painting, &c. is the Copying of a Design or Painting, by Means of a fine linnen Cloth, an oiled Paper, or other transparent Matter, whereon the the Strokes appearing through, are followed and traced with a Pencil, with or without Colour.

COUNTER FORTS, Buttresses, Spurs, or Pillars of Masonry, serving to prop or sustain Walls

or Terrasses subject to bulge, or be thrown down.

These Works are usually bent into Arches, and placed at a Distance from each other.

When any Thing is built on the Descent of a Mountain, it must be strengthened with *Counterforts* well bound to the Wall, and at the Distance of about twelve Yards from each other.

Counter Gage, in Carpentry, a Method used in measuring the Joints, by transferring, *v. g.* the Breadth of a Mortoise to the Place in the Timber where the Tenon is to be, in order to make them fit each other.

Counter Light, in Painting, a Window or Light opposite to any Thing which makes it appear to a Disadvantage.

Counter Mure } a little Wall

Counter Wall } built close to another, to fortify and secure it, that it may not receive any Damages from Buildings made contiguous to it.

COURSE, in Architecture, a continued Range of Stones, level, or of the same Height throughout the whole Length of the Building, without being interrupted with any Aperture.

A *Course of Plinths*, is the Continuity of a *Plinth* of Stone or Plaster in the Face of a Building, to mark the Separation of the Stones.

COUSSINET [*q. d.* a *Cushion*] in Architecture, signifies the Stone which crowns a *Piedroit* or *Peer*, or that lies immediately over the Capital of the *Impost*, and under the *Sweep*. The Bed of it is level below, and curved above, receiving the first

Rise or Spring of the Arch or Vault.

Coussinet is also used for the Ornament in the *Ionic* Capital, between the Abacus and the Echinus or Quarter-Round, and which serves to form the *Volutes*.

It is thus named from its representing a Cushion or Pillow, press'd by the Weight over it, and bound with the Strap or Girdle, called, by *Vitruvius*, *Baltheus*.

CRAMPOONS, } Pieces of
CRAMPONS, } Iron that are hooked at the Ends, for the drawing or pulling up of Timber, Stones, &c.

CRANK, a Contrivance or Machine, in manner of an Elbow, only of a square Form, projecting out from an Axis or Spindle; and serving by its Rotation, to raise and fall the Pistons of Engines for raising Water, &c.

CROSETTE, in Architecture, the Returns in the Corners of Chambranes, or Door-Cases, or Window-Frames, called also Ears, Elbows, Ancones, Prothyrides.

The *Crosette* of a *Luthern* is the Plaster or Covering near a Luthern.

CROSS GARNETS. See HINGES

CROSS-Grain'd. Timber is said to be *cross-grain'd*, where a Bough or some Branch shoots out on a Part of the Trunk of the Tree; for the Bough or Branch shooting forwards, the *Grain* of that Branch shoots forwards also, and so runs across the *Grain* of the Trunk; and if it

it be well grown together, it will scarce be perceived in some Stuffs, but only in working.

CROSS Multiplication. See MULTIPLICATION.

CROWN POST, in Architecture, a Post which in some Buildings stands upright in the Middle, between two principal Rafters.

Crown, in Architecture, the uppermost Member of the Cornice, called also Corona, and Larmier.

CROWNING, in Architecture, is generally understood when any Thing terminates or finishes a Decoration of Architecture: Thus a Cornice, a Pediment, Acroteres, &c. are called *Crownings*.

And thus also the Abacus is said to crown the Capital: And any Member or Moulding is said to be crowned, when it has a Fillet over it: And a Niche is crown'd, when it is cover'd with a Capital.

CRYPTA [of κρυπτα, *Gr.* to hide] a subterraneous Place or Vault, especially under a Church, for the Interment of particular Families or Persons.

Vitruvius uses the Word for Part of a Building, answering nearly to our Cellar. Hence,

CRYPTO PORTICO, a subterraneous Place, arched or vaulted, used as an Underwork or Passage into old Walls. The same Words are also used for the Decoration at the Entry of a Grotto.

CUBATURE, ζ is the CUBICATION, $\S$ being of a Solid, or the measuring of the

VOL. I.

Space comprehended in a Solid, as in a Cone, Pyramid, Cylinder, &c.

The *Cubature* has Respect to the Content of a Solid as the Quadrature has to the Superficies of a Figure: So that the *Cubature* of the Sphere turns on the same Thing as the Quadrature of the Circle.

CUBE, in Geometry, a regular or solid Body, consisting of six square and equal Faces and Sides, and its Angles all right, and therefore equal.

The *Cube* is supposed to be generated by the Motion of a square Plane along a Line equal to one of its Sides, and at Right Angles thereto: Whence it follows, that the Planes of all Sections parallel to the Base, are Squares equal thereto, and consequently to one another.

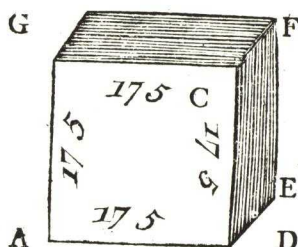
Cube, ζ in Arithmetick Numbers, $\S$ tick, is a Number arising from the Multiplication of a square Number by its Root: Thus if the square Number 4 be multiplied by its Root 2, the Factum 8 is a *Cube* or *Cube Root*.

Cube is a square Solid, comprehended under six Geometrical Squares, being in the Form of a Dye, to find the solid Content. This is,

The RULE,

Multiply the Side of the *Cube* into itself, and that Product again by the Side, the last Product will be the Solidity or solid Content of the *Cube*.

C U



C U

$$\begin{array}{r}
 17.5 \\
 17.5 \\
 \hline
 875 \\
 1225 \\
 175 \\
 \hline
 306.25 \\
 17.5 \\
 \hline
 153125 \\
 214375 \\
 30625 \\
 \hline
 5359.375 \text{ the solid Content.}
 \end{array}$$

Suppose ABCDEFG a Cubical Piece of Stone or Wood, each Side thereof being seven-teen Inches and a half, multiply 17.5 by 17.5, and the Product is 306.25; which being multiply'd by 17.5, the last Product will be 5359 solid Inches and 375 Parts.

To reduce the solid Inches to Feet, divide by 1728, (because there are so many Cubical Inches in a Foot,) and the solid Feet in the Cube will be 3, and 175 Cubical Inches remaining.

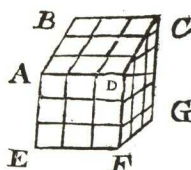
By Scale and Compasses.

Extend the Compasses from 1 to 17.5, and that Extent turn'd over twice from 17.5, will reach to 5359 the solid Content in Inches: Then extend the Compasses to 1, turn'd the same Way from 5359, and they will reach to 3.1 Feet.

DEMONSTRATION.

If the Square ABCD be conceived to be mov'd down the Plane ADEF always remain-

ing parallel to itself, there will be generated by such a Motion, a Solid having six Planes; the two opposite of which will be equal and parallel to each other; whence it is called a Parallelo-pipedon, or square Prism.



And if the Plane ADEF be a Square equal to the generating Plane ABCD, then will the generated Solid be a Cube.

From hence such Solids may be conceived to be constituted of an infinite Series of equal Squares, each equal to the Square ABCD, and AE or DF will be the Number of Terms.

Therefore, if the Area of ABCD be multiply'd into the Number of Terms AE, the Product is the Sum of all that Series, (*per* Lemma 1.) and consequently the

the Solidity of the Parallelopipedon, or *Cube*.

Or if the Base ABCD, being divided into little square Areas, be multiply'd into the Height AE, divided into a like Measure for Length: After this Way, you may conceive as many little *Cubes* to be generated in the whole Solid, as is the Number of the little Areas of the Base, multiply'd by the Number of Divisions the Side AE contains.

Thus if the Side of the Base AB be 3, that multiply'd into itself is 9, which is the Area of the square Base ABCD; then if AE be likewise 3, multiply 9 by 3, and the Product will be 27; and so many little *Cubes* will this Solid be cut into.

From this Demonstration, it is very plain, that if you multiply the Area of the Base of any Parallelogram into its Length, or Height, that Product will be the solid Content of such a Solid.

Extraction of the CUBE ROOT.

To extract the *Cube Root*, is nothing else but to find such a Number, as being first multiply'd into itself, and then into that Product, produceth the given Number. Which to perform, observe these following Directions:

First, You must point your given Number, beginning with the Unit's Place, and make a Point or Dot over every third Figure towards the Left Hand.

Secondly, Seek the greatest *Cube Number* in the first Point, towards the Left Hand, putting

the Root thereof in the Quotient, and the said *Cube Number* under the first Point, and subtract it therefrom, and to the Remainder bring down the next Point, and call that the Resolvend.

Thirdly, Triple the Quotient, and place it under the Resolvend, the Unit's Place of this, under the Ten's Place, and call this the triple Quotient.

Fourthly, Square the Quotient, and triple the Square, and place it under the triple Quotient, the Units of this under the Ten's Place of the triple Quotient, and call this the triple Square.

Fifthly, Add these two together, in the same Order as they stand, and the Sum shall be the Divisor.

Sixthly, Seek how often the Divisor is contain'd in the Resolvend, rejecting the Unit's Place of the Resolvend, (as in the square Root,) and put the Answer in the Quotient.

Seventhly, Cube the Figure last put into the Quotient, and put the Unit's Place thereof under the Unit's Place of the Resolvend.

Eighthly, Multiply the Square of the Figure last put in the Quotient, and place the Product under the last, one Place more to the Left Hand.

Ninthly, Multiply the triple Square by the Figure last put in the Quotient, and place it under the last, one Place more to the Left Hand.

Tenthly, Add the three last Numbers together, in the same Order as they stand, and call that the Subtrahend.

Lastly, Subtract the Subtrahend from the Resolvend, and if

there be another Point, bring it down in the Remainder, and call that a new Resolvend; and proceed in all Respects as before.

Example 1. Let 314432 be a *Cubick Number*, whole Root is required.

314432 (68 Root.
216

98432 Resolvend.

18 Triple Quotient of 6.
108 Triple Square of the Quotient 6.

1098 Divisor.

512 Cube of 8, the last Figure of the Root.
1152 The Square of 8, by the triple Quotient.
864 The triple Square of the Quotient 6 by 8.

98432 The Subtrahend.

.....

After you have pointed the given Number, seek what is the greatest *Cube Number* in 314, you will find the first Point to be 216, which is the nearest that is less than 314, and its Root is 6; which put in the Quotient, and 216 under 314, and subtract it therefrom, and there remains 98; to which bring down the next Point, 432, and annex to 98; so will it make 98432 for the Resolvend. Then triple the Quotient 6, it makes 18, which write down, the Unit's Place, 8, under 3, the Ten's Place of the Resolvend. Then square the Quotient 6, and triple that Square, and it makes 108, which write under the triple Quotient, one Place on the Left Hand; then add those two Numbers together, and they make 1098

for the Divisor. Then seek how often the Divisor is contained in the Resolvend, (rejecting the Unit's Place thereof) that is, how often 1098 in 9843, which is 8 Times; put 8 in the Quotient, and the *Cube* thereof below the Divisor, the Unit's Place under the Unit's Place of the Resolvend. Then square the 8 last put in the Quotient, and multiply 64, the Square thereof, by the triple Quotient 18, the Product is 1152; set this under the *Cube* of 8, the Units of this under the Tens of that. Then multiply the triple Square of the Quotient by 8, the Figure last put in the Quotient, the Product is 864; set this down under the last Product, a Place more to the Left Hand. Then draw a Line under those
three

three, and add them together, and the Sum is 98432, which is called the Subtrahend; which being subtracted from the Refolvend, the Remainder is nothing; which shews the Number to be a true *Cubic Number*, whose Root is 68, that is, if 68 be cubed, it will make 314432.

For, if 68 be multiply'd by 68, the Product will be 4624; and this Product, multiply'd again by 68, the last Product is 314432, which shews the Work to be right.

$$\begin{array}{r}
 68 \\
 68 \\
 \hline
 544 \\
 \text{The Work } 408 \\
 \hline
 4624 \\
 68 \\
 \hline
 36992 \\
 27744 \\
 \hline
 \text{The Proof } 314432 \\
 \hline
 \end{array}$$

Example 2. Let the *Cube Root* of 5735339 be required.

After you have pointed the given Number, seek what is the greatest *Cube Number* in 5, the first Point, which you will find to be one; which place under 5, and 1, the Root thereof, in the Quotient; and subtract 1 from 5, and there remains 4; to which bring down the next Point, it

makes 4735 for the Refolvend. Then triple the 1, and it makes 3; and the Square of 1 is 1, and the Triple thereof is 3; which set one under another, in their Order, and added, makes 33 for the Divisor. Seek how often the Divisor is in the Refolvend, and proceed as in the last Example.

5735339 (179 Root.

1

4735 Refolvend.

3 The Triple of the Quotient 1, the first Figure.
3 The triple Square of the Quotient 1.

33 The Divisor.

343 The *Cube* of 7, the second Figure of the Root.
147 The Square of 7 multiply'd in the triple Quotient 3.
21 The triple Square of the Quotient multiply'd by 7.

3913 The Subtrahend.

822339 The new Refolvend.

51 The Triple Quotient 17, the two first Figures.
867 The triple Square of the Quotient 17.

8721 The Divisor.

729 The *Cube* of 9, the last Figure of the Root.
4131 The Square of 9, multiply'd by the triple Quotient 51.
7803 The triple Square of the Quotient 867 by 9.

822339 The Subtrahend.

.....

In this Example, 33, the first Divisor seems to be contain'd more than seven times in 4735, the Refolvend; but if you work

with 9 or 8, you will find that the Subtrahend will be greater than the Refolvend.

Some

Some more Examples for Practice,

32461759 (319 The Root.

27

5461 Refolvend.

9 The Triple of 3.
27 The triple Square of 3.

279 The Divisor.

1 The *Cube* of 1, the second Figure.
9 The triple Quotient by the Square of 1.
27 The triple Square multiply'd by 1, the second Figure.

2791 The Subtrahend.

2670759 A new Refolvend.

93 The Triple of 31.
2883 The triple Square of 31.

28923 The Divisor.

729 The *Cube* of 9, the last Figure.
7533 The Square of 9 by 93, the triple Quotient,
25947 The triple Square 2883 by 9.

2670759 The Subtrahend.

.....

84604519 (439 The Root.
64

20604 Resolvend.

12 The Triple of 4.
48 The triple Square of 4.

492 The Divisor.

27 The *Cube* of 3.
108 The Square of 3 by the triple Quotient.
144 The triple Square of 3.

15507 The Subtrahend.

5097519 The Resolvend.

129 The Triple of 43.
5547 The triple Square of 43.

55599 The Divisor.

729 The *Cube* of 9.
10449 The Square of 9 by 129.
49923 The triple Square by 9.

5097519 The Subtrahend.

.....

259697989 (638
216

43697 Refolvend.

18 The Triple of 6.
108 The triple Square of 6.

1098 The Divisor.

27 The *Cube* of 3, the second Figure.
162 The Square of 3 by 18.
324 The triple Square of 108 by 3.

34047 The Subtrahend.

9650989 Refolvend.

189 The Triple of 63.
11907 The triple Square of 63.

119259

512 The *Cube* of 8.
12096 The Square of 8 by 189.
95256 The triple Square of 11907 by 8.

9647072 The Subtrahend.

3917 The Remainder.

25917056

25917056 (295.9
8

17917 The Refolvend.

6 The Triple of 2.
12 The triple Square of 2.

126 The Divisor.

729 The *Cube* of 9, the second Figure.
486 The Square of 9 by 6.
108 The triple Square by 9.

16389 The Subtrahend.

1528056 The Refolvend.

87 The Triple of 29.
2523 The triple Square of 29.

25317 The Divisor.

125 The *Cube* of 5, the third Figure.
2175 The Square of 5 by 87.
12615 The triple Square by 5.

1283375 The Subtrahend.

244681000 The Refolvend.

885 The Triple of 295.
261075 The triple Square of 295.

2611635 The Divisor.

729 The *Cube* of 9, the last Figure.
71685 The Square of 9 by 885.
2349675 The triple Square by 9.

235685079 The Subtrahend.

8995921 The Remainder.

In this Example I annex 3 Cyphers to the Remainder, which makes the third Refolvend; by which Means I bring one to the Place of Decimals. And so you may proceed to more decimal Places at Pleasure, by annexing three Cyphers to the next Remainder, and carrying on the Work, as before.

22069810125

C U

22069810125 (2805
8

14069 Refolvend.

126 The Triple of 2.
The triple Square of 2.

126 The Divisor.

512 The *Cube* of 8.
384 The Square of 8 by 6.
96 The triple Square by 8.

13952 The Subtrahend.

117810125 New Refolvend.

84 The Triple of 28.
2352 The triple Square of 28.

23604 The Divisor.

840 The Triple of 280.
235200 The triple Square of 280.

2352840 New Divisor.

125 The *Cube* of 5.
21000 The Square of 5 by 840.
1176000 The triple Square by 5.

117810125 The Subtrahend.

.....

C U

In this Example, 13952 being subtracted from the Refolv. 14069, the Remainder is 117; to which bring down 810, the third Point, and it makes 117810, for a new Refolvend; and the next Divisor is 23604, which you cannot have in the said Refolv. (the Unit's Place being rejected,) so you must put 0 in the Quotient, and seek a new Divisor, (after you have brought down your last Point to the Refolvend;) which new Divisor is 2352840; which you'll find to be contained 5 times. So proceed to finish the rest of the Work.

93759.575070 (45.42
64

29759 The Resolvend.

12 The Triple of 4, the first Figure.
48 The triple Square of 4.

492 The Divisor.

125 The *Cube* of 5, the second Figure.
300 The Square of 5 by 12, the triple Quotient.
240 The triple Square by 5.

27125 The Subtrahend.

2634575 The Resolvend.

135 The Triple of 45.
6075 The triple Square of 45.

60885 The Divisor.

64 The *Cube* of 4.
2160 The Square of 4 by 135
24300 The triple Square by 4.

2451664 The Subtrahend.

182911070 The Resolvend.

1362 The Triple of 45.4.
618348 The triple Square of 45.4.

6184842 The Divisor.

8 The *Cube* of 2.
5448 The Square of 2 by 1362.
1236696 The triple Square by 2.

123724088 The Subtrahend.

59186982 The Remainder.

In extracting the *Cube Root* of a mix'd Number, always observe to make the decimal Part to consist of either three, six, nine, &c. Places, that is, always to consist of even Points, as in the last Example, where the decimal Places were five, to which

I annexed a Cypher to make up six, and so I proceed to point it; and by that Means I have a Point falls upon the Unit's Place of whole Numbers, which you must always observe.

To extract the Cube Root out of a Fraction.

This is the same to do as in whole Numbers, observe but the foregoing Directions for the

true pointing thereof; for, as was before directed, the Decimal must always consist of three, six, nine, &c. Places; and if it be not so, it must be made so, by annexing of Cyphers, as is above said.

If the *Cube Root* of a vulgar Fraction be required, you must first reduce it to a Decimal, and then extract the Root thereof.

Examples of each follow.

Example 1. Let the *Cube Root* of .401719179 be required.

.401719179 (.737 Root.

343

58719 Resolvend.

21 Triple of 7.

147 Triple Square of 7.

1491 Divisor.

27 *Cube* of 3.

189 Square of 3 by 21.

441 Triple Square by 3.

46017 Subtrahend.

12702179 Resolvend.

219 Triple of 73.

15987 Triple Square of 73

160089 Divisor.

343 *Cube* of 7.

10731 Square of 7 by 219.

111909 Triple Square by 7.

11298553 Subtrahend.

1403626 Remainder.

Example

C U

Example 2. Let the *Cube Root* of .0001416 be required.

.000141600 (.052 Root.

125

16600 Refolvend.

15 The Triple of 5.
75 Triple Square of 5.

765 Divisor.

8 Cube of 2.
60 Square of 2 by 15.
150 Triple Square by 2.

15608 Subtrahend.

992 Remainder.

Example 3. Let $\frac{202}{276}$ be a vulgar Fraction, whose *Cube Root* is required.

By this Rule, reduce the vulgar Fraction to a Decimal.

276) 5.000000000 (.018115942

.....
2240
320
440
1640
2600
1160
560
8

C U

.018115942 (.262 Root.
8

10115 Refolvend.

6 Triple of 2.
12 Triple Square of 2.

126 Divisor.

216 Cube of 6. (of 2.
216 Square of 6 by the Triple
72 The triple Square by 6.

9576 Subtrahend.

539942 Refolvend.

78 Triple of 26.
2028 Triple Square of 26.

20358 Divisor.

8 Cube of 2.
312 Square of 2 by 78.
4056 Trip. Square of 2028
(by 2.

408728 Subtrahend.

131214 Remainder.

You may prove the Truth of the Work, by cubing the Root found, as was shewn in the first Example; and if any Thing remains, add it to the said *Cube*, and the Sum will be the given Number, if the Work is rightly perform'd.

I will

C U

I will shew the Proof of the fifth Example, the given Number being 259697989, whose Root is

C U

638, it being a surd Number, there remains 3917.

$$\begin{array}{r}
 638 \\
 638 \\
 \hline
 5104 \\
 1914 \\
 3828 \\
 \hline
 \text{The Square} \quad 407044 \\
 638 \\
 \hline
 3256352 \\
 1221132 \\
 2442264 \\
 \hline
 \text{The Cube} \quad 253694072 \\
 \text{The Remainder add} \quad 4917 \\
 \hline
 \text{Proof equal to the given Number} \quad 259697989 \\
 \hline
 \hline
 \end{array}$$

CUBICLE, a Bed-Chamber.

CULINARY, of or belonging to a Kitchen.

CULVERTAIL, the same as Dovetail.

CUPOLA, a spherical Vault, or the Round-Top of the Dome of a Church, in Form of a Cup inverted. Some call it a Lanthorn.

CURLING STUFF, in Joinery. See CROSS-GRAIN'D.

CURTICONE, in Geometry, a Cone whose Top is cut off by a Plane parallel to its Basis.

CURVATURE of a Line, is its Bending, or Flexure, whereby it becomes a Curve of such peculiar Properties.

CURVE, in Geometry, a Line, wherein the several Points it consists of tend several Ways, or are posited towards different Quarters.

In this Sense the Word is used in Opposition to a straight Line, whose several Points are pointed towards the same Quarter.

CURVILINEAL, crooked-lined, or consisting of crooked Lines.

Curvilinear Figures, in Geometry, are Spaces bounded by crooked Lines; as Circles, Ellipses, spherical Triangles, &c.

CYCLOID, in Geometry, one of the mechanical; or, as others term them, the transcendental Curves, called also the *Trochoid*.

Cycloidal Space, the Space contained between the *Cycloid* and the Subtense thereof.

CYCLOMETRY, the Art of measuring Cycles, or Circles.

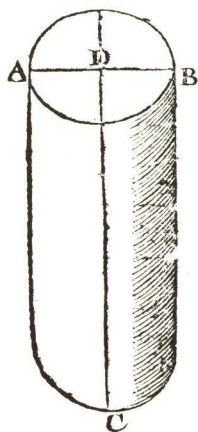
CYLINDER,

C U

CYLINDER, is a round Solid, having its Bases circular, equal and parallel, in the Form of a Rolling-Stone.

To find the solid Content, this is the Rule.

Multiply the Area of the Base by the Length, and the Product is the solid Content.



Let ABC be a Cylinder, whose Diameter AB is 21.5 Inches, and the Length CD is

$$\begin{array}{r}
 67.54 \\
 16 \\
 \hline
 40524 \\
 6754 \\
 \hline
 12) 1080.64 \\
 \hline
 9005
 \end{array}$$

$$\begin{array}{r}
 90.05 \\
 5.04 \\
 \hline
 95.09
 \end{array}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{add}$$

$$\begin{array}{r}
 363.05 \\
 2 \\
 \hline
 144) 726.10 (5.04 \\
 \hline
 610 \\
 \hline
 34
 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 12 to 67.54, (the Circumference)

C U

16 Feet; what is the solid Content?

First square the Diameter 21.5, and make it 462.25; which multiplied by .7854, and the Product will be 363.05115.

Then multiply this by 16, and the Product will be 5808.8164. Divide this last Product by 144, and the Quotient will be 40.34 Feet, the solid Content.

By Scale and Compasses.

Extend the Compasses from 13.54 to 21.5, the Diameter, and that Extent (turned twice over from 16, the Length,) will at last fall upon 40.34, the solid Content.

To find the superficial Content.

First find the Circumference of the Base 67.54; which being divided by 12, the Quotient will be 5.628 Feet, the curved Surface: To which add 5.04 Feet, the Sum of the two Bases, and the Sum will be 10.668 Feet, the whole superficial Content.

that Extent will reach from 16 (the Length) to 90.05 Feet, the curve Surface.

And

And extend the Compasses from 12 to 21.5 (the Diameter,) that Extent turn'd twice from *7854, will at last fall upon 2.52 the Area of one Base, which doubled is 5.04: This being added to the curve Surface, makes 95.09 Feet, the whole superficial Content.

DEMONSTRATION.

The solid Content of every *Cylinder* is found by multiplying the Area of its Base into its Height, as aforesaid: For every Right *Cylinder* is only a round Prism, being constituted of an infinite Series of equal Circles; that of its Base or End being one of the Terms; and its Height CD (in the Figure) is the Number of all the Terms.

Therefore the Area of its Base AB being multiply'd into CD, will be its Solidity. Let $D=AB$, and $H=CD$.

CYLINDROID is a Frustum of a Cone, having its Bases parallel to each other, but unlike.

The RULE.

To the longest Diameter of the greater Base, add half the longest Diameter of the lesser Base, and multiply the Sum by the shortest Diameter of the greater Base, and reserve the Product.

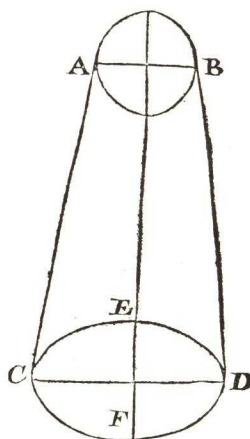
Then to the longest Diameter of the lesser Base add half the longest Diameter of the lesser Base, and multiply the Sum by the shortest Diameter of the lesser Base, and add the Product to the former reserved Sum, and that Sum will be the triple

VOL. I.

Square of a mean Diameter; which multiply'd by .7854, and that Product multiply'd by a third Part of the Height, the Product will be the solid Content.

EXAMPLE.

Let ABCD be a *Cylindroid*, whose Bottom Base is an Oval, the transverse Diameter being fourty-four Inches; and the upper Base is a Circle, whose Dia-



meter is twenty-six Inches, and the Height of the Frustum is nine Feet; what is the Solidity?

To 44 (the greater Diameter of the lower Base,) add 13, (half the Diameter of the lesser Base,) and the Sum will be 57; which being multiply'd by 14, (the conjugate Diameter of the greater Base,) the Product will be 798; which reserve.

Then, to 26, (the Diameter of the lesser Base) add 12, (half the transverse Diameter of the greater Base,) and the Sum will be 38; which being multiply'd

U

by

C Y

by 26, (the Diameter of the lesser Base,) the Product will be 1248; to which add the former reserv'd Product, and the Sum will be 2046, which being multiply'd by 7854, the Product will

$$\begin{array}{r}
 44 = CD \\
 13 = \text{half } AB \\
 \hline
 57 \text{ Sum} \\
 14 = EF \\
 \hline
 228 \\
 57 \\
 \hline
 798 \text{ Prod. ref.} \\
 \hline
 2046 \\
 7854 \\
 \hline
 8184 \\
 10230 \\
 16368 \\
 14322 \\
 \hline
 1606.9284
 \end{array}$$

C Y

be 1606.9284; which being multiply'd by 3, (a third Part of the Height,) the Product will be 4820.7852; which divided by 144, the Quotient will be 33.47 Feet, the solid Content.

$$\begin{array}{r}
 1606.9284 \\
 3 \\
 \hline
 144) 4820.7852 (33.47 \\
 \hline
 500 \\
 687 \\
 1118 \\
 \hline
 110
 \end{array}$$

The Rule being the same as that of the Frustum of a Rect-angled Pyramid or Prismoid; the Proof of that may serve as a sufficient Proof of this.

To find the superficial Content.

Add the Periphery of the Circle 81.68 to the Periphery of the Ellipsis 97.41, and the Sum will be 179.09; the half of which, 89.545, being multiply'd by 9, the Product will be 805.905; which being divided by 12, the Quotient will be 67.16 Feet, the curve Surface: Then the Area of

the Ellipsis is 3.36 Feet; and the Area of the Circle is 3.68 Feet; both which, added to the curve Surface, the Sum will be 74.2 Feet, the whole superficial Content.

CYMA in Architecture. See CIMA, SIMA, and CYMATIUM.

CYMATIUM, } [of the
CIMATIUM, } Greek $\kappa\upsilon\mu\alpha\tau\iota\sigma\mu$, a lit-
CIMA, } tle Wave] a Member or Mould-
ing of the Cornice, the Profile
of which is waved, *i. e.* con-
cave at top, and convex at bot-
tom. Which is oftentimes cal-
led also *Doucine Gorge*, or *Gula*
recta

recta Goletta, by the *Italians*; but most usually *Cymatium*, among us, as being the last, or uppermost Member, *q. d.* the *Cima* or Summit of the Cornice.

Some write it *Simaise*, from *Simus* an Ape, or *Camus* flattened; but this Etymology seems not proper: The Beauty of the Moulding consisting in its having its projecture equal to its Height.

M. *Felibien* indeed will not allow of this Etymology; and contends, that the Moulding is not so denominated from its being the uppermost Member of the Cornice, but upon its being waved; which is the Opinion of *Vitruvius*.

Vitruvius does not confine *Cymatium* to the Cornice, but uses it indifferently for any similar Moulding, wherever he meets with it. In which he differs from the most accurate among the Moderns.

Felibien makes two Kinds of *Cymatiums*; the one right, and the other inverted: In the first, that Part which projects the farthest is concave, and is otherwise called *Gula recta*, and *Doncine*.

In the other the Part that projects farthest is convex, called *Gula inversa*, or *Salon*.

The *English* Architects don't usually give the Name of *Cymatium* to these Mouldings, except when they are found on the Tops of Cornices. But the Workmen use the Name indifferently, wherever they are found.

Tuscan Cymatium consists of an *Ovolo* or Quarter-Round. *Phi-*

lander makes two *Doric Cymatiums*; of which this is one. *Baldus* calls this the *Lesbian Astragal*.

The *Doric Cymatium* is a *Cavetto*, or a Cavity less than a *Semicircle*, having its Projecture subduple to its Height.

Lesbian Cymatium, according to *Vitruvius*, is what our Architects otherwise call *Talon*, *viz.* a Concavo-convex Member, having its Projecture subduple its Height.

CYPRESS-TREE is of two Sorts, Wild, and the Sative, or Garden one, the most pyramidal and beautiful, and which is preposterously called the Male, and bears Cones.

The *Cypress* is a tall Tree, and shoots forth from its Roots a straight Stalk, divided into several Branches that bear Leaves very much indented, thick, and of a brownish-green Colour. At the Ends of these Branches grow Flowers like Cats Tails, composed of several little straight Leaves or Scales, and barren.

Those who would have *Cypress* in Standards, and grow wild, which may in Time come to be of large Substance, fit for the most immortal of Timber, and, indeed, are the least obnoxious to the Rigour of Winter, provided they be never clipped or disbranched, must plant the Male Sort. It prospers wonderfully where the Ground is hot and gravelly. The *Venetians* make great Profit of this Tree.

The Timber of *Cypress* is useful for Chests, Musical Instruments, and other Utensils; for it resists the Worm, and Putrefaction;

D A

faction, because of the Bitterness of its Juice. It never rifts nor cleaves, but with great Violence. And it may be worth observing, that the *Venetians* formerly made a considerable Revenue of it out of *Candia*; till the Forest there being set on Fire, either through Malice, or by Accident, in the Year 1400. It burnt seven Years together, because of the unctuous Nature of the Timber.

The Gates of *St. Peter's Church* at *Rome* were made of *Cypress* Wood, and lasted six hundred Years as fresh as if they had been new, till Pope *Eugenius* ordered Gates of Brass in their Stead.

The Chests of the *Egyptian* Mummies are, many of them, made of this Wood. The *Candians* and *Maltese* use it in building.

The Root of the wilder Sort of *Cypress* is of an incomparable Beauty, by reason of its crisped Undulations. It was antiently made use of in building Ships, by *Alexander*, and others. And some will have it, that *Gophir*, of which *Noah's Ark* was built, was *Cypress*. *Plato* preferred it to Brass itself, for writing his Laws on.

D A

DADO, in Architecture, the Dye, or that Part in the Middle of the Pedestal of a Column which is between its Base and Cornice. It is of a cubick Form, and thence takes the Name of Dye.

DEALS. *Of Dressing them*: The Dressing of *Deals* is the

D E

rough Planing of them over with a Fore-Plane, in order to dry.

Mr. *Wing* says, this Work is worth 1s. per Score: Though some say, they have had them done for 9d.

Of the laying of *Deal-Floors*, i.e. the Planing and Joining them, is worth 5s. per Square.

But if the Floors be laid with Dovetail or Key-Joints, without Pins or Nails, some Workmen say, they have 10s. per Square for Workmanship only; but if the Workman finds Deals, and lays them the ordinary Way, it is worth from 24s. to 30s. per Square, according to the Goodness of the *Deals*.

But if the *Deals* are extraordinary, and laid either with Dovetail or Key-Joints (without Nails or Pins,) 'tis worth 35s. or 40s. per Square. See FLOORS.

DECAGON, in Geometry, is a plain Figure of ten Sides, and as many Angles; and if all the Sides are equal, and all the Angles, it is called a *Regular Decagon*, and may be inscribed in a Circle.

If the Side of a *Regular Decagon* be 1, the the Area thereof will be 8.69; whence as 1 to 8.69, so is the Side of the Square of any given *Decagon* to the Area of that *Decagon*.

DECASTYLE, in the antient Architecture, a Building with an Ordonance of ten Columns in Front, as the Temple of *Jupiter Olympius* was.

DECIMALS. A *Decimal Fraction* is an artificial Way of setting down and expressing of Natural or Vulgar Fractions, as whole

D E

Numbers: And whereas the Denominators of Vulgar Fractions are divers, the Denominators of *Decimal Fractions* are always certain: For a *Decimal Fraction* hath always for its Denominator an Unit, with a Cypher or Cyphers annexed to it, and must therefore be either 10, 100, 1000, 10000, &c. And therefore, in writing down a *Decimal Fraction*, there is no Necessity of writing down the Denominator; for by bare Inspection it is certainly known, it consisting of an Unit, with as many Cyphers annexed to it, as there are Places (or Figures) in the Numerator.

D E

Example. This *Decimal Fraction* $\frac{1}{1000}$, may be written thus, .25, its Denominator being known to be an Unit with two Cyphers; because there are two Figures in the Numerator. In like Manner $\frac{1}{1000}$ may be thus written, .125; and $\frac{3}{1000}$ thus, .3575; and $\frac{7}{1000}$ thus, .075; and $\frac{6}{10000}$ thus, .0065.

As whole Numbers increase in a Decuple, or tenfold Proportion, towards the Left Hand, so, on the contrary, *Decimals* decrease towards the Right Hand, in a decuple Proportion, as in the following Scheme.

Tens of Millions.	
Millions.	
Hundreds of Thousands.	
Tens of Thousands.	
Thousands.	
Hundreds.	
Tens.	
Units.	
Tenth Parts.	
Hundredth Parts.	
Thousandth Parts.	
Ten Thousandth Parts.	
Hundredth Thousandth Parts.	
Millionth Parts, &c.	

Hence it appears, that Cyphers put on the Right Hand of whole Numbers, do increase the Value of those Numbers in a decuple, or tenfold Proportion; but being annexed to the Right Hand of a *Decimal Fraction*, do neither increase nor decrease the Value thereof: So $\frac{2500}{10000}$ is equivalent to $\frac{25}{100}$ or .25. And, on the contrary, though in whole Numbers, Cyphers prefixed be-

fore them, do neither increase nor diminish the Value, yet Cyphers before a *Decimal Fraction* do diminish its Value in a decuple Proportion: For .25, if you prefix a Cypher before it, becomes $\frac{2}{10}$, or .025: And .125 is $\frac{125}{1000}$, by prefixing two Cyphers before it, thus, .00125. And therefore, when you are to write a *Decimal Fraction*, whose Denominator hath more Cyphers

phers than there are Figures in the Numerator, they must be supply'd by prefixing so many Cyphers before the Figures of your Numerator; as suppose $\frac{1}{1000}$ were to be written down without its Denominator; here, because there are three Cyphers in the Denominator, and but two Figures in the Numerator, therefore prefix a Cypher before 19, and set it down thus, .019.

The Integers are separated from the *Decimals* several Ways, according to Mens Fancies; but the best and most usual Way, is by a Point or Period; and if there be no whole Number, then a Point before the Fraction is sufficient: Thus if you were to write down $317 \frac{1}{1000}$, it may be thus express'd, 317.217; and $59 \frac{2}{1000}$, thus, 59.0025; and $\frac{7}{1000}$, thus, .0075, &c.

Reduction of Decimals.

In Reduction of *Decimals*, there are three Cases. *First*, To reduce a Vulgar Fraction to a *Decimal*. *Secondly*, To find the Value of a *Decimal* in the known Parts of Coin, Weights, Measures, &c. *Thirdly*, To reduce Coins, Weights, Measures, &c. to a *Decimal*. Of these, in their Order.

1. To reduce a Vulgar Fraction to a Decimal.

The RULE.

As the Denominator of the given Fraction is to its Numerator, so is an Unit (with a com-

petent Number of Cyphers annex'd) to the *Decimal* requir'd.

Therefore, if to the Numerator given, you annex a competent Number of Cyphers, and divide the Result by the Denominator, the Quotient is the *Decimal* equivalent to the Vulgar Fraction given.

Example 1 Let $\frac{1}{4}$ be given to be reduced to a *Decimal* of two Places, or having 100 for its Denominator.

To 3 (the Numerator given) annex two Cyphers, and it makes 300; which divide by the Denominator 4, and the Quotient is .75, the *Decimal* required, and is equivalent to $\frac{1}{4}$ given.

Note, That so many Cyphers as you annex to the given Numerator, so many Places must be pricked off in the *Decimal* found; and if it shall happen that there are not so many Places of Figures in the Quotient, the Deficiency must be supply'd, by prefixing so many Cyphers before the Quotient-Figures, as in the next Example.

Example 2. Let $\frac{2}{3}$ be reduced to a *Decimal*, having six Places.

To the Numerator annex six Cyphers, and divide by the Denominator, and the Quotient is 5235: But it was required to have six Places, therefore you must prefix two Cyphers before it, and then it will be .005235, which is the *Decimal* required, and is equivalent to $\frac{2}{3}$.

See the Work of these two Examples.

$$4) 3.00(.75$$

$$\begin{array}{r}
 4) 3.00(.75 \quad 573) 3.000000(5235 \\
 \underline{28} \\
 20 \\
 \underline{20} \\
 .. \\
 \underline{} \\
 345
 \end{array}$$

In the second Example, there remains 345, which Remainder is very insignificant, it being less than $\frac{1}{1000000}$ Part of an Unit, and therefore is rejected.

II. *To find the Value of a Decimal in the known Parts of Money, Weight, Measures, &c.*

THE RULE.

Multiply the given *Decimal* by the Number of Parts in the next inferior Denomination, and from the Product prick off so many Places to the Right Hand as there were Places in the *Decimal* given; and multiply those Figures prick'd off by the Number of Parts in the next inferior Denomination and prick off so many Places as before, and so continue to do, till you have brought it to the lowest Denomination required.

Example 1. Let .7565 of a Pound Sterling be given to be reduced to Shillings, Pence, and Farthings.

Multiply by 20, by 12, and 4, as the Rule directs, and always prick off four Places to the Right Hand, and you will find it to make 15s. 1d. 2q. See the Work.

$$\begin{array}{r}
 .7565 \\
 20 \\
 \hline
 s. \\
 15 \\
 1300 \\
 12 \\
 \hline
 d. \\
 1.5600 \\
 4 \\
 \hline
 q. \\
 2.2400 \\
 \hline
 \hline
 \end{array}$$

A more compendious Way of finding the Value of a Decimal of a Pound Sterling.

Double the first Figure, (or Place of Primes,) and it makes so many Shillings; and if the next Figure (or Place of Seconds) be 5, or more than 5, for the 5 add another Shilling to the former Shillings; then for every Unit in the second Place count ten, and to that add the Figure in the third Place, and reckon that so many Farthings; but if they make above 13, abate 1; and if it be above 38, abate 2, and add the remaining Farthings to the Shillings before found.

Example 1. Let .695 of a Pound be reduced to Shillings, Pence, and Farthings.

First, Double your 6, and it makes 12s. then take 5 out of 9, and for that reckon another Shilling, and it makes 13s. and the 4 remaining is four Tens, and the 5 makes 45, which being above 38, you must therefore cast away 2, and there rests 43 Farthings, which is 10d. $\frac{3}{4}$. So the Answer is 13s. 10d. $\frac{3}{4}$.

D E

G E

So the Value of $.725 = 14 \text{ } 6$
 And the Value of $.878 = 17 \text{ } 6\frac{3}{4}$
 And the Value of $.417 = 8 \text{ } 4$
 And so of any other.

Let $.59755$ of a Pound Troy be reduced to Ounces, Penny-Weights, and Grains.

$$\begin{array}{r} .59755 \\ 12 \\ \hline 7.17060 \\ 20 \\ \hline 3.41200 \\ 24 \\ \hline 164800 \\ 82400 \\ \hline 9.88800 \end{array}$$

Multiply by 12, by 20, and by 24, and always prick off five Places towards the Right Hand, and you will find the Answer to be $7 \text{ oz. } 3 \text{ pwt. } 10 \text{ gr. } \text{ferè}$. See the Work.

Facit oz. pwt. gr.
 $7 \text{ } 3 \text{ } 9.888$

Let $.43569$ of a Ton be reduced to Hundreds, Quarters, and Pounds.

Multiply by 20, by 4, and by 28, and the Answer will be $8 \text{ C. } 2 \text{ qrs. } 24 \text{ lb. } \text{ferè}$.

$$\begin{array}{r} .43569 \\ 20 \\ \hline \end{array}$$

$$\begin{array}{r} 8.71380 \\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 2.85520 \\ 28 \\ \hline \end{array}$$

$$\begin{array}{r} 23.94560 \end{array}$$

Facit $8 \text{ } 2 \text{ } 23.9456$

$$\begin{array}{r} .9595 \\ 12 \\ \hline \end{array}$$

$$\begin{array}{r} 11.5140 \\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 2.0560. \end{array}$$

Facit $11 \text{ Inches } 2 \text{ Qrs.}$

III. To reduce the known Parts of Money, Measure, &c. to a Decimal.

The RULE.

Let $.9595$ of a Foot be reduced into Inches, and Quarters.

To the Number of Parts of the lesser Denomination given, annex a competent Number of Cyphers, and divide by the Number of such Parts that are contained in the greater Denomination, to which the *Decimal* is to be

DE

be brought ; and the Quotient is the *Decimal* sought.

Example 1. Let 6*d.* be reduced to the *Decimal* of a Pound.

To 6 annex a competent Number of Cyphers, (suppose 3) and divide the Result by 240, (the Pence in a Pound,) and the Quotient is the *Decimal* requir'd.

$$\begin{array}{r} 240 \overline{) 6.000} (.025 \\ \underline{1200} \\ \dots \\ \hline \end{array} \quad \text{Facit } .025$$

Example 2. Let 3*d.* $\frac{1}{4}$ be reduced to the *Decimal* of a Pound, having six Places.

In 3*d.* $\frac{1}{4}$ there are fifteen Farthings, therefore to 15 annex six Cyphers, (because there are to be six Places in the *Decimal* requir'd,) and divide by 960, (the Farthings in a Pound,) and the Quotient is .015625.

$$\begin{array}{r} \text{C. qr. lb.} \\ 9 \quad 1 \quad 16 \\ 4 \\ \hline 37 \text{ qrs.} \\ 28 \\ \hline 302 \quad \text{Facit } .469642 \\ 75 \\ \hline 10552 \text{ Pounds.} \\ \hline \end{array}$$

DE

$$\begin{array}{r} 96 \overline{) 15.00000} (.015625 \\ \dots \\ \hline 540 \\ 600 \\ 240 \\ 480 \\ \hline \dots \\ \hline \end{array}$$

Example 3. Let 3 $\frac{1}{4}$ Inches be reduced to the *Decimal* of a Foot, consisting of four Places.

In three $\frac{1}{4}$ Inches there are 13 Quarters; therefore to 13 annex four Cyphers, and divide by 48, (the Quarters in a Foot,) and the Quotient is .2708.

$$\begin{array}{r} 48 \overline{) 13.0000} (.2708 \\ \hline 340 \\ 400 \\ \hline 16 \\ \hline \end{array}$$

Example 4. Let 9*C.* 1*qr.* 16*lb.* be reduced to the *Decimal* of a Ton, having six Places.

$$\begin{array}{r} 224 \overline{) 1052.00000} (.469642 \\ \dots \\ \hline 15600 \\ 21600 \\ 14400 \\ 9600 \\ 6400 \\ \hline 1920 \\ \hline \end{array}$$

Addition

DE

Addition of Decimals.

Addition of *Decimals* is perform'd the same Way as Addition of whole Numbers, only you must observe to place your Num-

$$\begin{array}{r} 317.25 \\ 17.125 \\ 275.5 \\ 47.3579 \\ 12.75 \\ \hline \end{array}$$

Sum 669.9829

This is so plain, that more Examples I think needless.

Subtraction of Decimals.

Subtraction of *Decimals* is per-

bers right, that is, Units under Units, Primes under Primes, Seconds under Seconds, &c.

Example. Let 317.25, 17.125, 275.5, 47.3579, and 12.75, be added together into one Sum.

form'd likewise the same Way as in whole Numbers, Respect being had to the right placing the Numbers, (as in Addition,) as in the following Examples.

(1)

$$\begin{array}{r} \text{From} \quad 212.0137 \\ \text{Subtr.} \quad 31.1275 \\ \hline \text{Refts} \quad 180.8862 \\ \hline \text{Proof} \quad 212.0137 \\ \hline \end{array}$$

(3)

$$\begin{array}{r} \text{From} \quad 2051.315 \\ \text{Subtr.} \quad 79.172 \\ \hline \text{Refts} \quad 1972.143 \\ \hline \text{Proof} \quad 2051.315 \\ \hline \end{array}$$

(2)

$$\begin{array}{r} \text{From} \quad 201.1250 \\ \text{Subtr.} \quad 5.5785 \\ \hline \text{Refts} \quad 195.5465 \\ \hline \text{Proof} \quad 201.1250 \\ \hline \end{array}$$

(4)

$$\begin{array}{r} \text{From} \quad 30.5 \\ \text{Subtr.} \quad 7.2597 \\ \hline \text{Refts} \quad 23.2403 \\ \hline \text{Proof} \quad 30.5 \\ \hline \end{array}$$

Note, If the Number of Places in the *Decimals* be more in that which is to be subtracted, than in that which you subtract

from, you must suppose Cyphers to make up the Number of Places, as in the fourth Example.

Multiplication

D E

Multiplication of Decimals.

Multiplication of *Decimals* is also perform'd the same Way as Multiplication of whole Numbers; but to know the Value of the Product, observe this Rule.

Cut off, or separate by a Comma, or Prick, so many *Decimal Places* in the Product, as there are Places of *Decimals* in both Factors, *viz.* in the Multiplicand and Multiplier, which I shall farther explain in the following Examples.

Let 3.125 be multiplied by 2.75; multiply the Numbers together, as if they were whole Numbers, and the Product is 8.59375; and because there were three Places of *Decimals* prick'd off in the Multiplicand, and two Places in the Multiplier, therefore you must prick off five Places of *Decimals* in the Product, as you may see by the Work.

$$\begin{array}{r}
 3.125 \\
 \times 2.75 \\
 \hline
 15625 \\
 21875 \\
 6250 \\
 \hline
 8.59375
 \end{array}$$

Let 79.25 be multiplied by .459.

In this Example, because two Places of *Decimals* are prick'd off in the Multiplicand, and

D E

three in the Multiplier, therefore there must be five prick'd off in the Product.

$$\begin{array}{r}
 79.25 \\
 \times .459 \\
 \hline
 71325 \\
 39625 \\
 31700 \\
 \hline
 36.37575
 \end{array}$$

Let .135272 be multiplied by .00425.

In this Example, because in the Multiplicand are six *Decimal Places* and in the Multiplier five Places; therefore in the Product there must be eleven Places of *Decimals*, but when the Multiplication is finished, the Product is but 57490600, *viz.* only eight Places; therefore, in this Case, you must prefix three Cyphers before the Product-Figures, to make up the Number of eleven Places; so the true Product will be .00057490600.

$$\begin{array}{r}
 .135272 \\
 \times .00425 \\
 \hline
 676360 \\
 270544 \\
 541088 \\
 \hline
 .00057490600
 \end{array}$$

More

D E

More Examples for Practice.

.001472	.017532
.1045	347
7360	122724
5888	70128
1472	52596
<u>.0001538240</u>	<u>6.083604</u>

279.25	32.0752
.445	.0325
139625	1603760
111700	641504
111700	962256
<u>124.26625</u>	<u>1.04244400</u>

4.443	20.0291
15.98	35 45
35544	1001455
39987	801164
22215	1001455
4443	600873
<u>7099914</u>	<u>710.031595</u>

7.3564	.75432
.0126	.0356
441384	452592
147128	377160
73564	226296
<u>.09269064</u>	<u>.026853792</u>

D E

Contracted Multiplication of Decimals.

Because in Multiplication of *Decimal Parts* and mix'd Numbers, there is no need to express all the Figures of the Product, but in most Cases two, three, or four Places of *Decimals* will be sufficient; therefore, to contract the Work, observe this following

R U L E.

Write the Unit's Place of the Multiplier under that Place of the Multiplicand, whose Place you intend to keep in the Product; then invert the Order of all the other Figures, that is, write them all the contrary Way. Then in multiplying always begin at that Figure in the Multiplicand which stands over the Figure you are then multiplying withal, and set down the first Figure of each particular Product directly one under the other; but yet a due Regard must be had to the Increase arising from the Figures on the Right Hand of that Figure in the Multiplicand, which you begin to multiply at. This will appear more plain by Examples.

EXAMPLE I.

Let 2.38645 be multiply'd by 8.2175, and let there be only four Places retain'd in the *Decimals* of the Product.

First,

DE

First, according to the Directions, write down the Multiplicand, and under it write the Multiplier, thus ; Place 8 (being the Unit's Place of the Multiplier) under 4, the fourth Place of *Decimals* in the Multiplicand, and write the rest of the Figures quite contrary to the usual Way, as in the following Work : Then begin to multiply, first the 5 which is left out, (only with Regard to the Increase, which must be carry'd from it,) saying, 8 times 5 is 40, carry 4 in your Mind, and say 8 times 4 is 32, and 4 I carry is 36 ; set down 6, and carry 3, and proceed through the rest of the Figures, as in common Multiplication : Then begin to multiply with 2, saying, two times 4 is 8, for which I carry 1, (because it is above 5,) and say, two times 6 is 12, and 1 that I carry is 13 ; set down 3, and carry 1, and proceed through the rest of the Figures : Then multiply with 1, saying, once 6 is 6, for which carry 1, and say, once 8 is 8, and 1 is 9 ; set down 9, and proceed : Then multiply with 7, saying, seven times 8 is 56, for which carry 6, (because it is above 55,) and say, seven times 3 is 21, and 6 that I carry is 27 ; set down 7, and carry 2, and proceed : Then multiply with 5, saying, five times 3 is 15, for which carry 2, and say, five times 2 is 10, and 2 I carry is 12, which set down, and add all the Products together ; and the total Product will be 19.6107. See the Work.

DE

$$\begin{array}{r}
 2.38645 \\
 5712.8 \\
 \hline
 190916 \\
 4773 \\
 239 \\
 167 \\
 12 \\
 \hline
 19.6107
 \end{array}$$

Note, That in multiplying the Figure left out every time next the Right Hand in the Multiplicand, if the Product be 5, or upwards to 10, you carry 1 ; and if it be 15, or upwards to 20, carry 2 ; and if 25, or upwards to 30, carry 3, &c.

I have here set down the Work of the last Example, wrought by the common Way, by which you may see both the Reason and Excellency of this Way, all the Figures on the right Hand the Line being wholly omitted.

$$\begin{array}{r}
 2.38645 \\
 8.2175 \\
 \hline
 1193225 \\
 1670515 \\
 238645 \\
 477290 \\
 1909160 \\
 \hline
 19.610652875
 \end{array}$$

Example 2. Let 375.13758 be multiplied by 167324, so that the Product may have but four Places of *Decimals*.

First,

First, set 6, the Unit's Place of the Multiplier, under 5, being the fourth Place of *Decimals* in the Multiplicand, (because four Places of *Decimals* were to be prick'd off,) and write all the rest of the Figures backward. Then multiply all the Figures of the Multiplicand by 1, after the common Way. Then begin with the second Figure of the Multiplier 6, saying six times 8 is 48, for which I carry 5, (in respect of the 8 left out,) and six times 5 is 30, and 5 that I carry is 35; set down 5 and carry 3, and proceed after the common Method. Then begin with 7, the third Figure of the Multiplier, and say, seven times 5 is 35, for which carry 4, and say, seven times 7 is 49, and 4 I carry is 53; set down 3 under the first, and carry 5, and proceed

as before. Then beginning with 3, the fourth Figure of the Multiplier, and say, three times 7 is 21, carry 2, and say three times 3 is 9, and 2 I carry is 11; set down 1, and carry 1, and proceed as before. Then begin with 2, the fifth Figure, and say, two times 3 is 6, for which I carry 1, and say, two times 1 is 2, and 1 carry is 3; set down 3; and two times 5 is 10; set down 0, and carry 1, and proceed as before. Then begin with 4, the last Figure of the Multiplier, and say, four times 1 is 4, for which I carry nothing, because 'tis less than 5; then say, four times 5 is 20; set down 0, and carry 2; and proceed through the rest of the Figures of the Multiplicand. Then add all up together, and the Product is 6276.9520. See the Work.

375.13758 the Multiplicand.
 4237.61 the Multiplier revers'd.

37513758 the Product with 1.
 22508255 the Product with 6 increas'd with 6×8 .
 2625963 the Product with 7 increas'd with 7×5 .
 112541 the Product with 3 increas'd with 3×7 .
 7503 the Product with 2 increas'd with 2×3 .
 1500 the Product with 4 increas'd with 0.

6276.9520 the Product requir'd.

Let the same Example be repeated, and let only one Place in the
Decimals be prick'd off.

375.13758 the Multiplicand.
4237.61 the Multiplier inverted.

37514 the Product by 1 with the Increase of 1×7 .
22508 the Product with 6 increased with 6×3 .
2626 the Product of 7 increased with 7×1 .
113 the Product with 3 increased with 3×5 .
7 the Product with 2 increased with 2×7 .
1 the Increase only of 4×3 .

6276.9 the Product is the same as before.

More Examples for Practice.

Multiply 395.3756 by .75642, and prick off four Places in
Decimals.

395.3756 the Multiplicand.
24657. the Multiplier revers'd.

2767629 the Product by 7 increased with 7×6 .
197688 the Product by 5 increased with 5×5 .
23722 the Product by 6 increased with 6×7 .
1581 the Product by 4 increased with 4×3 .
79 the Product by 2 increased with 2×5 .

299.0699 the Product required.

Let the same Example be repeated, and let there be only one
Place of *Decimals*.

395.3756
24657.

1767 the Product by 7 increased with $7 \times$
198 the Product by 5 increased with 5×5 .
24 the Product by 6 increased with $6 \times 9 + 6 \times 5$.
2 the Increase of $4 \times 9 + 4 \times 3$.

299.1 the Product.

Characters, and their Signification,

R U L E S.

Note, That this Mark $+$ signifies Addition; as $8+5$, that is, 8 more 5, or 8 added to 5; and $8+3+7$ denotes these Numbers are to be added into one Sum.

This — signifies Subtraction, as $9-4$ signifies that 4 is to be taken from 9.

This Mark $\times$ signifies Multiplication, as 7×5 signifies that 7 is to be multiply'd into 5.

This Mark $\div$ signifies Division, as $12\div 4$ signifies 12 is to be divided by 4.

This Mark signifies Equality, or Equation; that is, when $=$ is placed between Numbers, or Quantities, it denotes them to be equal, as $7+5=12$, that is, 7 more 5 is equal to 12; and $15-7=8$, that is, 15 less by 7, is equal to 8, or subtract 7 from 15, and there remains 8.

This Mark $::$ is the Sign of Proportion, or the Golden Rule, it being always placed betwixt the two middle Terms or Numbers in Proportion, thus, $4:20::6:30$, to be thus read, as 4 is to 20, so is 6 to 30.

Division of Decimals.

Division of *Decimals* is perform'd after the same Manner as Division of whole Numbers; but to know the Value or Denomination of the Quotient, is the only Difficulty; for the resolving of which, observe either of the following

I. The first Figure in the Quotient must be of the same Denomination with that Figure in the Dividend which stands (or is to be supposed to stand) over the Unit's Place in the Divisor, at the first seeking.

II. When the Work of Division is ended, count how many Places of *Decimal* Parts there are in the Dividend more than in the Divisor, for that Excess is the Number of Places which must be separated in the Quotient for *Decimals*: But if there be not so many Figures in the Quotient, as is the said Excess, that Deficiency must be supply'd with Cyphers in the Quotient, prefixed before the significant Figures thereof, towards the Left Hand, with a Point before them; so shall you plainly discover the Value of the Quotient.

These following Directions ought also to be carefully observ'd.

If the Divisor consists of more Places than the Dividend, there must be a competent Number of Cyphers annexed to the Dividend, to make it consist of as many (at least) or more Places of *Decimals* than the Divisor; for the Cyphers added must be reckon'd as *Decimals*.

Consider whether there be as many *Decimal* Parts in the Dividend as there are in the Divisor; if there be not, make them so many, or more, by annexing of Cyphers.

In

D E

In dividing of whole or mixed Numbers, if there be a Remainder, you may bring down more Cyphers, and by continuing your Division, carry the Quotient to as many Places of *Decimals* as you please.

These Things being considered, I shall proceed to the Practice of Division of *Decimals*, which I shall endeavour to explain in as familiar and as easy a Method as possible.

Example 1. Let 48 be divided by 144.

In this Example the Divisor 144 is greater than the Dividend 48; therefore, according to the Directions above, I annex a competent Number of Cyphers, (*viz.* four,) with a Point between them, and divide according to the usual Way.

$$\begin{array}{r}
 144 \overline{) 48.0000(.3333} \\
 \underline{480} \\
 480 \\
 \underline{480} \\
 48
 \end{array}$$

But, first, in seeking how often 144 in 48.0, (the first three Figures of the Dividend,) I find the Unit's Place of the Divisor to fall under the first Place of the *Decimals*; therefore the first Figure in the Quotient is in the first Place of *Decimals*: Or, by

VOL. I.

D E

the second Rule, there being four Places of *Decimals* in the Dividend, and none in the Divisor; so the Excess of *decimal* Places in the Dividend, above that in the Divisor, is four; so that when the Division is ended, there must be four Places of *Decimals* in the Quotient. See the Work.

Example 2. Let 217.75 be divided by 65.

First, in seeking how oft 65 in 217, (the first three Figures of the Dividend,) I find the Unit's Place of the Divisor to fall under the Unit's Place of the Dividend; therefore the first Figure in the Quotient will be Units, and all the rest *Decimals*. Or, by the second Rule, there being two Places of *Decimals* in the Dividend, and no *Decimals* in the Divisor, therefore the Excess of *decimal* Places in the Dividend, above the Divisor, is two; so when the Division is ended, separate two Places in the Quotient towards the Right Hand by a Point. See the Work.

$$\begin{array}{r}
 65 \overline{) 217.75(3.35} \\
 \underline{217} \\
 227 \\
 \underline{325} \\
 000 \\
 000
 \end{array}$$

X

Example

D E

Example 3. Let 267.15975 be divided by 13.25.

$$13.25)267.15975(20.163$$

$$\begin{array}{r} \text{.....} \\ \hline 2159 \\ 8347 \\ 3975 \\ \hline \text{....} \\ \hline \end{array}$$

In this Example, 3, the Unit's Place of the Divisor, falls under 6, the Ten's Place of the Dividend; therefore (by the first Rule) the first Figure in the Quotient is Tens. Or, by the second Rule, the Excess of *Decimal* Places in the Dividend, above the Divisor, is three; there being five Places of *Decimals* in the Dividend, and but two in the Divisor, so there must be three Places of *Decimals* in the Quotient.

Example 4. Let 15.675159 be divided by 375.89.

$$375.89)15.675159(.0417$$

$$\begin{array}{r} \hline 63955 \\ 263669 \\ \hline 546 \\ \hline \end{array}$$

In this Example, 5, the Unit's Place of the Divisor, falls under 7, the second Place of *Decimals* in the Dividend; therefore (by the first Rule) the first Figure in the Quotient is in the

D E

second Place of *Decimals*; so that you must put a Cypher before the first Figure in the Quotient; And (by the second Rule) the Excess of *decimal* Places in the Dividend, above the Number of *decimal* Places in the Divisor, is 4; for the *decimal* Places in the Dividend is 6, and the Number of Places in the Divisor but two; therefore there must be four Places of *Decimals* in the Quotient. But the Division being finished after the common Way, the Figures in the Quotient are but three, therefore you must prefix a Cypher before the significant Figures.

Example 5. Let 72.1564 be divided by .1347.

$$.1347)72.1564(535.68$$

$$\begin{array}{r} \hline 4806 \\ 7654 \\ 9190 \\ 11080 \\ \hline 304 \\ \hline \end{array}$$

In this Example, the Divisor being a *Decimal*, the first Figure thereof falls under the Ten's Place in the Dividend; therefore the Units (if there had been any) should fall under the Hundred's Place in the Dividend; and so the first Figure in the Quotient is Hundreds. And, by the second Rule, there being four Places of *Decimals* in the Dividend, and as many in the Divisor, so the Excess is nothing; but in dividing, I put two Cyphers

DE

phers to the Remainders, and continue the Division in two Places farther, so I have two Places of *Decimals*. See the Work.

Example 6. Let .125 be divided by .0457.

$$.0457 \overline{) .1250000} (2.735$$

$$\begin{array}{r} \underline{914 \cdot} \\ 3360 \\ 3199 \\ \hline 1610 \\ 1371 \\ \hline 2390 \\ 2285 \\ \hline 105 \end{array}$$

In this Example, the Unit's Place of the Divisor (if there had been any) would fall under the Units Place of the Dividend; therefore the first Figure of the Quotient is Units. And by the second Rule, there being seven Places of *Decimals* in the Dividend, and but four Places in the Divisor, so the Excess is three; therefore there must be three Places of *Decimals* in the Quotient.

I shall set down only the Work of some few Examples more, and so proceed to *Contracted Division*.

DE

$$.00456 \overline{) .0000059791} (.00131$$

$$\begin{array}{r} \underline{\hspace{1cm}} \\ 1419 \\ 511 \\ \hline 55 \end{array}$$

Let it be divided by 282.

$$282 \overline{) 1.0000000} (.0035461 \text{ ferè.}$$

$$\begin{array}{r} \underline{\hspace{1cm}} \\ 1540 \\ 1300 \\ 1720 \\ 280 \end{array}$$

$$.325 \overline{) .4000000} (1.2307$$

$$\begin{array}{r} \underline{\hspace{1cm}} \\ 750 \\ 1000 \\ 2500 \\ \hline 225 \end{array}$$

$$.042 \overline{) 495.00000} (11785.71$$

$$\begin{array}{r} \underline{\hspace{1cm}} \\ 75 \\ 330 \\ 360 \\ 240 \\ 300 \\ 60 \\ \hline 18 \end{array}$$

Division of Decimals contracted.

In Division of *Decimals* the common Way, when the Divisor hath many Figures, and it is required to continue the Division till the Value of the Remainder be but small, the Operation will sometimes be large and tedious, but may be excellently contracted by the following Method.

The RULE.

By the first Rule of this Chapter, find what is the Value of the first Figure in the Quotient ;

then, by knowing the first Figure's Denomination, you may have as many or as few Places of *Decimals* as you please, by taking as many of the left Hand Figures of the Divisor as you think convenient for the first Divisor ; and then take as many Figures of the Dividend as will answer them ; and in dividing, omit one Figure of the Divisor at each following Operation. A few Examples will make it plain.

Example 1. Let 721.17562 be divided by 2.25743, and let there be three Places of *Decimals* in the Quotient.

$$\begin{array}{r}
 2.25743 \overline{) 721.17562} \quad (319.467 \\
 \underline{677229} \\
 43946 \\
 \underline{22574} \\
 21372 \\
 \underline{20317} \\
 1055 \\
 \underline{903} \\
 152 \\
 \underline{135} \\
 17 \\
 \underline{15} \\
 2 \\
 \underline{}
 \end{array}$$

In this Example the Unit's Place of the Divisor falls under the Hundred's Place in the Dividend, and it is required that three Places of *Decimals* be in the Quotient ; so there must be six Places in all, that is, three Places of the whole Numbers,

and three Places of *Decimals*. Then, because I can have the Divisor in the first six Figures of the Dividend, I cut off the 62 with a Dash of the Pen, as useless ; then I seek how oft the Divisor in the Dividend, and the Answer is three Times ; put three in

D E

in the Quotient, and multiply and subtract as in the common Division, and the Remainder is 43946. Then prick off three in the Divisor, and seek how often the remaining Figures may be had in 43946, the Remainder, which can be but once; put 1 in the Quotient, and multiply and subtract, and the next Remainder is 21372. Then prick off the 4 in the Divisor, and seek how often the remaining Figures may be had in 21372, which will be 9 times; put 9 in the Quotient, multiply thus; saying nine times 4 is 36, for which I carry 4, (in respect of the 4 last prick'd off,) and nine times 7 is 63, and 4 is 67; set down 7, and carry 6, and so proceed till the Division be finished, always respecting the Increase made from the Figures prick'd off. Observe the Work, which will better inform you than many Words.

$$2.25743 \overline{) 721.17562} (319.467$$

$$\begin{array}{r}
 677229 \overline{) 72117562} \\
 \underline{439466} \\
 225743 \\
 \underline{213723} \\
 2031687 \\
 \underline{1055450} \\
 902972 \\
 \underline{1524780} \\
 1354458 \\
 \underline{1703220} \\
 1580201 \\
 \underline{123019}
 \end{array}$$

D E

I have set down the Work of this last Example at large, according to the common Way, that thereby the Learner may see the Reason of the Rule, all the Figures on the right Side the perpendicular Line being wholly omitted.

Example 2. Let 5171.59165 be divided by 8.758615, and let it be required that four Places of *Decimals* be prick'd off in the Quotient.

$$8.758615 \overline{) 5171.59165} (590.4577$$

$$\begin{array}{r}
 43793075 \\
 \underline{7922841} \\
 7882754 \\
 \underline{40087} \\
 35034 \\
 \underline{5053} \\
 4379 \\
 \underline{674} \\
 613 \\
 \underline{61} \\
 61 \\
 \underline{} \\
 \dots
 \end{array}$$

In this Example I can't have 8, the first Figure in the Divisor, in 5, the first Figure of the Dividend; so that the Unit's Place of the Divisor falls under the Hundred's Place of the Dividend; so that there will be seven Figures in the Quotient, that is, three of whole Numbers, and four of *Decimals*; therefore there must be seven Figures in the Divisor,

X 3

(because

D E

(because the Number of Places in the Divisor and Quotient will be equal,) and there must be eight Places in the Dividend; so that I cut off the Figure 5 with a Dash, as uselefs. Thus having proportion'd the Dividend to the Divisor, and both to the Number of Places or Figures desired in the Quotient, I proceed to divide as before, saying, how often 8 in 51, which will be five times; put 5 in the Quotient, and multiply and subtract, and the Remainder is 7922841. Then I prick off the first Figure in the Divisor 5, and seek how often the remaining Figures of the Divisor are in the aforefaid Remainder, which I find 9 times; put 9 in the Quotient, and multiply thereby, saying, nine times 5 (the Figure prick'd off) is 45, for which I carry 5; and say nine times 1 is 9, and 5 I carry is 14; set down 4, and carry 1, and proceed to multiply the rest of the Figures, and subtract, and the Remainder will be 40087. Then prick off the Figure 1, and seek how often 87586 in the Remainder 40087, the Answer will be 0; so put 0 in the Quotient, and prick off the Figure 6, and seek how often 8758 in 40087, which will be four times; put 4 in the Quotient, and multiply, saying, four times 6 (the Figure last prick'd off) is 24, for which I carry 2; and say, four times 8 is 32; and 2 I carry is 34; set down 4 and carry 3; multiply the rest of the Figures, and subtract as before, and so proceed after the same Manner, until all the Figures of the Divisor be prick'd off, to the last Figure. See the Work.

D E

Example 3. Let 25.1367 be divided by 217.3543, and let there be five Places of *Decimals* in the Quotient.

In this Example, 7, the Unit's Place of the Divisor, falls under 1, the first Place of *Decimals*; therefore the first Figure of the Quotient is in the first Place of *Decimals*, so the Quotient will be all *Decimals*: Then because the Quotient-Figures, and the Figures of the Divisor will be of an equal Number, dash off the 43 in the Divisor, and the 7 in the Dividend, as uselefs, and divide as before.

$$\begin{array}{r}
 217.3543 \overline{) 25.1367} \quad (.11564 \\
 \underline{21735} \\
 3401 \\
 \underline{2174} \\
 1227 \\
 \underline{1087} \\
 140 \\
 \underline{130} \\
 10 \\
 8 \\
 \underline{} \\
 2 \\
 \underline{}
 \end{array}$$

Although I have hitherto given Directions for proportioning the Divisor and Dividend, so as to bring into the Quotient what Number of *Decimals* you please, yet there is no absolute Necessity for it; but you may carry on your Division to what Degree you please, before you begin to prick off the Figures of the Divisor, in order to contract the Work, as in the following Examples,

D E

D E

amples, where it is not required be done according to Discre-
to prick off any determinate tion.
Number of *Decimals*, but it may

2.756756) 7414.76717 (2689.67118

.....

...

5513512

19012551

16540536

24720157

22054048

2666109

2481080

185029

165405

19624

19297

327

276

51

28

23

22

1

X 4

12.34254)

DE

12.34254) 514.75498 (41.705757
... 4937016

2105338

1234254

871084

863978

7106

6171

935

864

71

62

9

8

1

DECK-NAILS. See NAILS.

DECORATION, in Architecture, an Ornament in a Church, or other publick Place; or what adorns and enriches a Building, Triumphal Arch, &c. either on the Inside or without.

The Orders of Architecture contribute a great deal to the *Decoration*; but then the several Parts of these Orders must have their just Proportion, Characters, and Ornaments; or otherwise the finest Order will bring Confusion rather than Richness.

Decorations in Churches are Paintings, Vases, Festoons, &c. occasionally placed on or against the Walls, but so discretionally, as not to take off any thing from the Form and Beauty of the Architecture, as is much practised in *Italy* at the solemn Feasts.

DE

Decorations also signify the Scenes of Theatres. The *Decorations* in Opera's, and other theatrical Performances, must be often changed, in Conformity to the Subject.

The Antients had two Sorts of *Decorations* for their Theatres: The first, called *Versatiles*, having three Sides or Faces, which were turned successively to the Spectators. The other, called *Duciles*, which were drawn or flidden before others.

The latter Sort of *Decoration* is still in use, and to greater Advantage among us than the Antients, who were under a Necessity of drawing a Curtain whenever a Change was made in the *Decoration*; whereas the Change is made in a Moment, and without scarce being perceiv'd upon our Stage.

DECORUM } i. e. *Decency*,
DECOR } is particular-

ly used in Architecture for the Suitableness of a Building, and the several Parts and Ornaments thereof, to the Station and Occasion.

Vitruvius is very exact in this Point, and gives Rules expressly for the appropriating or suiting the several Orders to their natural Characters: So that, e.g. a *Corinthian* Column should not be set at the Entrance of a Prison or Gate-House, or a *Tuscan* in the Portico of a Church, as has been done by some of our Builders, who have offended even in the Disposition of the Offices in our ordinary Houses; we often finding the Kitchen set where the Parlour should be; and that in the first and the best Story, which

which should have been condemned to the lowest and worst.

Some interpret *Decorum* to signify the observing a due Respect between the Inhabitant and Habitation: Whence *Palladio* concludes, that the principal Entrance must never be regulated by any certain Dimensions, but according to the Dignity of the Person who is to live in it; yet to exceed rather in the more than in the less, is a Token of Generosity, and may be excused with some notable Emblem or Inscription, as that of the *Conti di Bavilaigua* over his large Gate at *Verona*, (where probably there had been some Disproportion committed;) *Patet janua Cor magis*, i.e. My Gate is wide, but my Heart more wide.

DECUPLE, in Arithmetick, a Term of Relation or Proportion, implying a Thing to be ten times as much as another.

DECUSSION, in Geometry, Opticks, &c. the Point in which two Lines, Rays, &c. cross or intersect each other.

DEFICIENT NUMBERS, in Arithmetick, are such, whose Parts added together, make less than the Integer, e.g. 8, whose quota Parts are 1, 2, and 4, which together make no more than 7.

DENTICLES, in Architecture, an Ornament in Corniches, bearing some Resemblance to Teeth, particularly affected in the *Ionic* and *Corinthian* Orders.

They are cut on a little square Member, properly called *Denticulus*; and the Notches or Ornaments themselves *Dentes*, from *Dens*, *L.* as resembling a Row of Teeth.

In antient Times *Dentils* were never used in the *Ionic* Cornice; yet they are found in the Remains of the Theatre of *Marcellus*; which some take for an Argument, that *Vitruvius* had not the Direction of that Building.

Vitruvius prescribes the Breadth of each *Dentil*, or Tooth, to be its Height; and the Indenture or Interval between each two, he directs to be two Thirds of the Breadth of the *Dentil*.

He also in his fourth Book observes, that the *Greeks* never put *Dentils* under Modillions, because Modillions represent Pur-lins; whereas *Dentils* represent the Ends of Rafters, which can never be placed underneath Pur-lins.

The *Romans* were not so scrupulous as to this *Decorum*, except in the Pantheon, where there are no *Dentils* under the Modillions, neither in the Portico, nor the Inside of the Building.

DESCRIBENT, in Geometry, a Term expressing some Line or Surface, which by its Motion produces a Plane Figure, or a Solid.

DESIGN, in Architecture, &c. is the Draught, or the Thought, Plan, geometrical Representation, Distribution, and Construction of a Building, &c.

In Building, the Term *Ich-nography* may be used, when by *Design* is only meant the Plan of a Building, or a flat Figure drawn on Paper. And when some Side or Face of the Building is raised from the Ground, we may use the Term *Orthography*; and when both Front and

and Sides are seen in Perspective, we may call it Scenography.

DESIGNING is the Art of delineating or drawing the Appearance of natural Objects by Lines on a Plane.

DIAGONAL, in Geometry, is a Right Line drawn across a Figure of several Sides, from the Vertex of one Angle. Some Authors call it Diameter, and others Diametral of the Figure.

First, It is demonstrated, that every *Diagonal* divides a Parallelogram into two equal Parts. *Secondly*, That two *Diaagonals* drawn in any Parallelogram, bisect each other. *Thirdly*, That the *Diagonal* of a Square is incommensurable with one of its Sides.

DIAGRAM, in Geometry, a Scheme for the Explanation or Demonstration of any Figure or Proportion belonging to it.

DIAL, an Instrument whereby to know the Hour or Time of the Day, when the Sun shines. The first *Sun-Dial* that was set up in *Rome*, was erected by *Papirius Cursor*, about the Year of the Cit., 447: For *Pliny* says, there was no Mention of any Account of Time, but of the Sun's Setting and Rising. This Dial was set up in the Temple of *Quirinus*, but it went not right.

About thirty Years after this, *M. Valerius Messala*, says *Varro*, being Consul, brought out of *Sicily*, from the taking of *Catana*, another *Dial* which he set up on a Pillar near the *Rostrum*; but it not being made for that particular Latitude, it could not go true. Nevertheless they made use of it for eleven Years;

and then *Marcus Philippus*, who was Cenfor with *Lucius Paulus*, set up another that was more exact.

The *Greeks* also were a long Time without Clocks and *Sun-Dials*. Some ascribe the Invention of *Sun-Dials* to *Anaximenes Miletius*, and others to *Thales*.

There are many Kinds of *Dials* mention'd by *Vitruvius*; as one invented by *Berosus* the *Chaldean*, which was on a reclining Plain, parallel almost to the Equinoctial, there was an half Circle upon it; and thence it was called *Hemicyclus*.

Aristarchus Samius found out the *Hemisphere-Dial*. And there were some Spherical ones with a Needle for a Gnomon. The Discus of *Aristarchus* was an *Horizontal Dial*, with its Limb raised up all round to prevent the Shadow from extending itself too far off.

Dial-Planes are of two Sorts. *First*, Such as are made on the Wall of a Building. Or, *Secondly*, such as are drawn on Tables of Wood, commonly called *Dial-Boards*.

The first Sort, if they are made on Brick Work is done by Plaistering on the Wall with Lime, Sand, and Hair mix'd: This, if well drench'd with Linseed Oil, after it is dry, or as long as it will drink in any, and afterwards with Oil and white Lead, may be durable enough.

But it will be a better Way to temper the Lime, Sand and Hair, with Ox Blood, which will be no great Charge, but of great Advantage; for this Mixture will equal in Time the Hardness

nefs of a Freestone, and keep the Surface as much from the Injuries of the Weather; but it must be afterwards painted white.

If you are to work on a Stone, the best Way is to drench the Stone with Linseed Oil and White Lead, very thin, till it will drink in no more; then will the *Dial* you paint upon last the longer, and be the better prepar'd to resist the Ruins of Time

Now for Tables or *Dial-Boards* of Wood, they being most common, I shall give such Directions for the making of them, as have been always found most profitable and fit for the Purpose.

The best Wood for this Purpose is the clearest Oak, and the reddest Fir, provided it be not turpentine. There is but little Difference between these two Woods as to their Alteration by the Weather, both being subject to split, in case they are bound, and have not free Liberty to shrink with dry Weather, and to swell with Wet. But as to their lasting, Oak seems to be the better of the two: Though good Red Fir that is hard, will ordinarily last the Age of a Man, if it be secured as such Things ought to be.

In working either of these Kinds of Woods, first cut the Boards to such a Length as you intend the Deal Board should be, and so many of them as may make up the Breadth designed; then let them be jointed on the Edges, and planed on both Sides, and afterwards set to dry: For it has been observ'd, that though Boards have lain in an

House ever so long, and are ever so dry, yet when they are thus shot and planed, they will shrink afterwards beyond Belief, if kept dry. When they have been thought to have been dry enough, and will shrink no more, let them be again shot with good Joints, and let every Joint be secured by two Wooden Dove-tails, let in cross the Joint on the Backside; but let this be done when the Boards are glued together, and well dry'd.

After they have been thus glued, and the Joints are sufficiently dry'd, then let the Face of the Board be well planed, and try'd every Way, that it may be both smooth and true, and all of a Thickness, as Pannels of Wainscot are commonly wrought.

The Edges must be thus true and even, that they may fit into the Rabet of a Moulding put round it, just as a Pannel of Wainscot does in its Frame. This will give Liberty to the Board to shrink, and swell without tearing; whereas Mouldings that are nailed round the Edge, as the common Way is, do so restrain the Motion of the Wood, that it cannot shrink without tearing; but Boards wrought after this Manner will last a long Time, without either parting in the Joints, or splitting in the Wood.

Dials are sometimes drawn on Planes lin'd with Copper or Lead, that they may be free from splitting or tearing; but a Board (if it be made as above directed) is thought preferable to them in many Respects.

As,

As, *First*, It is much cheaper. *Secondly*, Lead (and Copper too, a little) will swell with the Heat of the Sun, and grow in Time hollow outwards or convex, instead of a perfect Flat, so that the Truth of its Shadow will be much injured. *Thirdly*, the Colours will be apt to peel from the Metal, and the *Dial* will by that Means be in danger to be sooner defaced, than if it were painted on a Wooden Plane.

For Gluing the Joints of *Dial* Boards, see the Article GLUE.

Directions for Painting, &c. a Sun-Dial.

Four Colours are sufficient for this Work, *viz.* *Spanish Brown*, for the Priming, or first Colour.

White Lead for the second Colour, and finishing the Face of the Table.

Vermillion for drawing the Hour-Lines. And,

Lamp-Black for the Figures in the Margin, respecting the Lines of every Hour, if it be a plain *Dial*.

But if you would have the Figures gilded, then some others are required, as Gold, and the Size to lay it on, and Smalt, for a blue Ground, if you would have a rich Colour.

But some lay the Ground where the Figures are gilt, with *Vermillion*: And that shews well, if the Figures are listd with black, and a black Moulding round the *Dial*.

The next Particular should be the Practice of painting the *Dial*; but before that can be done, the Draught must be drawn; and

therefore it will not be unreasonable to direct to the best Authors who have wrote on the Subject of *Dialling*. As,

First, *Stirrup's Dialling*, as being of excellent Use to acquaint a young Learner with the Knowledge of the Sphere, that he may understand the Nature and Reason of *Dials*.

Secondly, *Collins's Dialling*, a very useful Book.

Thirdly, *Leybourn's Dialling*, in which you have the best Ways for drawing East and West *Dials*, and far *Decliners*.

Fourthly, *Collins's Sector on a Quadrant*: In which you have communicated the Cut of a Scale, that by knowing the Declination, gives all the rest of the Requisites of an Upright Decliner, by Inspection only, with as great Exactness, as by the nicest Calculation: Besides, it teaches the Way of drawing the Hours of a *Dial* by a Tangent Line, and also by the Scale of Hours; two of the best and most expeditious Ways that ever were yet found out.

The Practice of painting Sun-Dials.

When according to the Rules given in the Books before mentioned, you have drawn on the Paper the Draught of your *Dial*, and your Board is ready, and also your Colours prepared, according to the Directions before given, you should then in painting your *Dial*, proceed as follows:

Take *Spanish Brown*, that has been well ground, and mixed moderately

moderately thin, and with a large Bristle-Brush dipped in it, colour the Board or Plane all over, on the Back as well as on the Fore-side, to preserve it the better, so that no Part be left uncolour'd: This is called the Priming of a *Dial*. When this first Colour is dry, do it over again with more of the same Colour, temper'd somewhat thicker; and when this is also dry, you may, if you please, do it over again with the same Colour: The Work will be the substantialler, and last the longer.

When this last Time of Colouring with the Priming is done, then colour the Face of the *Dial-Plane* over with White Lead; and when that is dry, work it over again three or four Times more, successively after each Drying; and so will the Face of the *Dial-Plane* be sufficiently defended against the many Years Fury and Violence of the Weather.

When the last Colouring of the White is drawn, you must draw on the Plane, with a Black Lead Pencil, a Horizontal Line, so far distant from the uppermost Edge of the *Dial*, as your Discretion shall think fit, or your Experience finds shall be most becoming the Plane: Then set out the Margin of the *Dial* with Boundary Lines for the Hour, Half Hour, Quarters, and Quarter-Divisions of the *Dial*, as you see done in most *Dials*.

When the Margin and Boundary Lines of the *Dial* are set out, then take your Paper-Draught, that has been fairly drawn, and place the Horizon-

tal Line of that, on the Horizontal Line that you before drew on the Plane; in doing of which, observe to place the Centre according as the Situation of your Plane; for Convenience sake, requires. Thus if your *Dial* be a Full-South *Dial*, then let the Centre be exactly in the Middle of the Plane: But if your *Dial* decline from the South, either East or West, then place not the Centre of your Draught in the Centre of your Plane, but nearer to one Side or other of it, according as it declines, having also Regard to the Quantity of its Declination.

As for Example: If your *Dial* decline Eastwards, then let the Centre of your Draught be placed between the Centre and the Eastern Side of your Plane, the Quantity thereof must be according as your *Dial* declines: If it declines but a little, then place the Centre of your Draught but a little from the Centre of your Plane; and if it declines much, place the Centre of your Draught the more out of the Centre of your Plane.

The Reason of advising this, is, that by so doing you may gain a greater Distance for those Hour-Lines, which in declining Planes, fall nearer together on one Side than they are on the other: For which Reason, it is usual so to do in declining Planes, except they decline far, as between eighty and ninety Degrees: For in this Case, they are commonly drawn without Centres, to gain the greater Distance for the Hour-Lines.

When

When the Paper-Draught has been thus artificially placed on the Plane, and fastened with Pins, or small Tacks, then let the Draught of it be transferred on the Plane, by laying a Ruler over every Hour and Quarter-Division, and where the Ruler cuts or intersects the Boundary Lines of the Margin, there make Marks, by drawing Lines with a Black Lead Pencil, of such a Length as each Division requires, (or is design'd by your Boundary Lines,) observing always to draw the Hour and and Half Hour Lines quite through your Margin, that they may be Guides for the right placing of the Figures, and for a small Spot that is usually placed in the Margin, right against the Half Hour.

When this *Dial* Draught has been thus transferred to the Plane itself, you must not forget to draw the Subtilar Line according as it lies in your Draught, to be a Guide for the right placing the Stile or Cock; for you must be very exact in every Particular, or else the *Dial* will not be right.

Every Thing that is requir'd being taken from the Draught, and transferred to the Plane, then take the Draught off, and with Vermillion very well ground and prepar'd, as is before taught, let the Boundary Lines of your *Dial*, as also the Hour, Half Hour, and Quarter-Division be drawn therewith: Let your Colour be as thick and as stiff as you possibly can work it, so as to draw a clear and smooth Line; because this is to be done but once.

When your Vermillion Lines are drawn, then make the Figures with Lamp-Black, and a Spot in the Middle of the Margin, right against the Half Hour Line; and, if you please, in the Margin at the Top of your Plane, you may put the Date of the Year, your Name, and some Sentence as is usual in Things of this Nature. Then fit in your Cock, so as to make right Angles with the Plane. So shall your *Dial* be drawn, and finish'd in all Respects as a plain *Dial* ought to be.

If you would have the Figures in Gold, see GILDING.

DIAMETER, in Geometry, is a Right Line, passing through the Centre of a Circle, and terminating on each Side at its Circumference.

The Properties of the *Diameter*, are,

First, That it divides the Circumference into three equal Parts. And hence we have a Method of describing a Semi-circle upon any Line assuming a Point therein for the Centre.

Secondly, The *Diameter* is the greatest of all the Chords.

Thirdly, To find the Ratio of the *Diameter* to the Circumference.

Archimides has found the Ratio of the *Diameter* to the Circumference, as 7 to 22.

Modern Practical Geometrists assume the *Diameter* to be to the Circumference, as 100 to 314.

Ad. Metius gives us the Ratio of the *Diameter* to the Circumference, as 113 to 355, which is the most accurate of all those express'd

expres'd in small Numbers, as not erring 3 in 100000000.

Diameter of a Column, is that taken just above the Base. From this the Module is taken, which measures all the other Parts of a Column.

Diameter of the Swelling, is that taken at the Height.

Diameter of the Diminution of Columns, is that taken from the Top of the Shafts.

DIAMOND-GLASS. See QUARRY.

Diamond-Pavement. See PAVING.

DIAPHANOUS, transparent, or pellucid, *i.e.* giving Passage to the Rays of Light, as Water, Air, Glass, Talk, fine Porcelane, &c.

DIAPHANEITY, the Quality of a transparent or pellucid Body.

DIASTYLE, in the antient Architecture, an Edifice where the Columns stand at such a Distance one from another, that eight Modules, or four Diameters, are allowed for the Intercolumniation.

DIE, a Term apply'd to any square Body, as the Trunk or Naked of a Pedestal, which is that Part included between its Base and Cornice.

DIGGING. The *Digging* of the Ground for Cellars, and for the Foundations of Buildings, is commonly done by the Yard solid, containing twenty-seven solid Feet, which is commonly counted a Load.

Therefore take the Dimension in Feet, multiply the Length by the Breadth, and the Product by the Depth, and then divide the last Product by 27,

and the Quotient will give the Content in solid Yards.

DIMENSION is the Extension of a Body considered as capable of being measured.

Hence, as we conceive a Body extended, and capable of being measured in Length, Breadth, and Depth, we conceive a trine *Dimension*, viz. Length, Breadth, and Thickness. The first is called a Line, the second a Surface, and the third a Solid

DIMINISHING of Columns. See COLUMN, and DIMINUTION.

DIMINUTION, in Architecture, is the Contraction of the upper Part of a Column whereby its Diameter is made less than that of the lower Part.

All Architects have made their Columns less above than below, with Design to attain those two important Points in Architecture, Strength, and the Appearance.

Some again have made them a little bigger towards the Middle, than towards the Bottom, which is called the Swelling.

Indeed, neither *Diminution*, nor Swelling, are observed by the *Gothick* Architects, who make their Columns perfectly Cylindrical; for which Reason they are properly called Pillars, in Contradistinction to Columns.

The *Diminution of Columns* commences generally from one Third of the Height of the Column; though some begin it from the very Base of the Column, and so go on tapering to the Capital; but this is not esteemed to have so good an Effect.

Vitruvius himself would have the *Diminution* of Columns be different, according to their Height, and not according to their Diameter: As for Example, he diminishes a Column of 15 Feet in Height a sixth Part of its Diameter, and another of 50 only one eighth Part; but this Rule of *Diminution* is not found to have been observed in the Antique.

Mr. *Perrault* observes, that a Difference of Orders does not infer a Difference in *Diminutions*; there being in different Works of the same Order both small and great *Diminutions*; but however, except the *Tuscan* Order, which *Vitruvius* diminishes by a fourth Part; though *Vignola* does it only by a fifth, and the *Trajan* Column by a ninth.

Diminutions in Antique Buildings, are very differently adjusted, as well as in different modern Authors.

M. *Le Clerc* says, all *Diminutions* of Columns begin to diminish in Thickness from one Third of their Height. But in Proportion, as their Orders are more delicate, their *Diminution* ought to be less sensible.

For instance, in the *Tuscan* Order, where the Column is but 14 Modules high, its Semidiameter under the Astragal may be diminished six Minutes.

In the *Tuscan* Order, where the Column is 15 Modules high, its *Diminution* under the Astragal may be but 5 Minutes and a half.

In the *Doric* Order, where the Column is 16 Modules, the *Diminution* may be but five Minutes.

In the *Ionic*, where the Column is 18 Modules, the *Diminution* may be but four Minutes and a half.

And in the *Roman* and *Corinthian*, no more than four, that is, a *Diminution* of four Minutes on each Side the Axis, is the utmost that the Column will undergo, though it always increases in Height in Proportion to its Thickness.

Indeed, says he, according to some Authors, the *Diminution* of Columns, even of the same Order, ought to be greater or less, according as their Heights are greater or less.

For Instance, a *Doric* Column, say they, 20 Feet high, must have less *Diminution* than another of 15 Feet; and one of 30 less than one of 20. The Reason they give for this, is, that the Greatness of the Height easily imposes on the Sight; and hence they conclude, that a very tall Column must of itself appear diminished towards the Top.

Nor can it be denied, but that this holds true, where the Eye is placed near, and looks up from the Bottom to the Top of the Column; but then it is to be considered, that large Columns are never made with design to be viewed thus near; but always at a Distance suitable to their Height: And it would be ridiculous to spoil their Proportions, out of Complaisance to such as should please to view them at an improper Distance.

Therefore, says he, in my Opinion, when any certain *Diminution* of a Column has been once established, provided it does but please the Eye when viewed

at

at a Distance, it ought never to be changed on Occasion of any Alteration in the Height of the Column, excepting it should be found in some close narrow Place; which yet can never happen, unless in the Inside of a Building: For Instance; of a Dome, or the like; to which a prudent Architect will always have a particular Regard.

But, says he, here it must be remember'd, that I am here speaking of Columns of the same Order; for in different Orders the *Diminution* must be different. But as to the *Doric* Column, for Instance, be its Height an hundred Feet, or be it but ten, its *Diminution* should always be the same, at least, this is my Opinion.

DIOPTRICKS is the Doctrine of refracted Vision, which are also called *Diaclasticks*. They are properly the third Branch of Opticks, whose Office is to consider and explain the Effects of Light, refracted by passing through different Mediums of Air, Water, Glass, &c.

DIPTERE ζ in the antient **DIPTERON** ς Architecture, signified a Temple surrounded with two Rows of Columns, which form a sort of Portico's, called *Wings* or *Isles*.

Pseudo Diptere is the same, excepting, that instead of the double Row of Columns, this was only encompassed with a single one.

DIRECT VISION, in Opticks, is that which is perform'd by direct Rays, in Contradistinction to *Vision* by refracted or reflected Rays.

VOL. I.

Direct Vision is the Subject of Opticks, which prescribes the Laws and Rules thereof.

Direct Rays, are such as pass in direct Lines from the Luminary to the Eye; without being turned out of their rectilinear Direction by any intermediate Body, either opaque or pellucid.

Direct, in Arithmetick. The *Rule of Three Direct*, is that opposite to the *Inverse*. In the *Direct*, the fourth Number required increases the Proportion; and in the *Inverse*, diminishes it.

DIRECTION, in Mechanics, or *Line of Direction*, is particularly used for a Line passing from the Centre of the Earth through the Centre of Gravity of a Body, and the Support or *Fulcrum* that bears it. A Man must of Necessity fall down, as soon as the Centre of his Gravity is out of the *Line of Direction*.

Angle of Direction, in Mechanics, is that which is comprehended between the *Lines of Direction* of two conspiring Powers.

Line of Direction, in Mechanics, is that *Line* in which a Body moves, or endeavours to proceed.

Magnetical Direction is used, in the general, to signify the Tendency or Turning of the Earth, and all *magnetical Bodies*, to certain Points.

The Situation of our Earth is known to be such, that its Axis is the Axis of the Universe, and therefore its Poles and Cardinal Points correspond exactly to those of it.

This Situation some account for hence, that it is the most
Y commodious,

commodius, in respect to the Aspects and Influences of the heavenly Bodies, and renders it the fittest Habitation for Man.

Others maintain, that this Position of the Earth is the Effect of a magnetick Virtue; and suppose a celestial Pole, with a like magnetick Virtue, which extending as far as our Earth, draws the correspondent Part of it, the Pole, towards itself.

DIRECTLY, in Geometry, a Term used of two Lines, which are said to be *directly* against each other, when they are Parts of the same Right Line.

In Mechanics, a Body is said to strike *directly* against another, if it strike in a Right Line perpendicular to the Point of Contact.

A Sphere is said to strike *directly* against another, when the Line of Direction passes through both their Centres.

DIRECTRIX § in Geometry
DIRIGENT § try, a Term which expresses the Line of Motion, along which the described Line or Surface is carried in the *Genesis* of any Plane or solid Figure.

DISC § in Opticks, the Magnitude of Telescope-Glasses, or the Width of their Apertures, whatever their Figure be, whether plain, convex, meniscus, &c.

DISCREET PROPORTION §

DISJUNCT PROPORTION § is when the Ratio of two or more Pairs of Numbers, or Quantities, is the same, but not continual, that is, when the Ratio of the Consequent of one Pair of Numbers, or Quantities, to the Antecedent

of the next Pair, is not the same as of the Antecedent of one Pair to its Consequent; as $3 : 6 :: 8 : 16$ are *discreet Proportionals*, because the Ratio of 3 to 6, is equal to the Ratio of 8 to 16; but the Ratio of 3 to 6, or 8 to 16, is not the same as of 6 to 8.

Discreet Quantity is such as is not continuous, and joined together; as Numbers whose Parts being distinct Units, cannot be united into one *Continuum*; for in a *Continuum* there are no actual determinate Parts before Division, but they are potentially infinite.

DISTANCE is properly the shortest Line between two Points.

Line of Distance, in Perspective, is a Right Line drawn from the Eye to the principal Point.

Point of Distance, in Perspective, is a Point in the Horizontal Line, at such Distance from the principal Point, as is that of the Eye from the same.

DISPOSITION of *Pictures and Paintings*; the Manner how and where Gentlemen, &c. who are possessed of several Sorts of them, should place them in their Houses, &c.

I. Antique Works, or Grottesco, may become a Wall, and the Borders and Friezes of other Works; but if there be any Draughts in Figures of Men and Women to the Life on the Wall, they will be best of Black and White, or of one Colour heightened: If they be naked, let them be as large as the Place will afford: If of Marble Columns, Aqueducts, Arches, Ruins, and

and Cataracts, let them behold, high, and of large Proportion.

II. Let the best *Pièces* be placed to be seen with single Lights; for so the Shadows fall naturally, being always barred to answer one Light; and the more under or below the Light, the better, especially in Men's Faces, and large Pieces.

III. Let the Porch or Entrance into the House be set out with rustick Figures, and Things rural.

IV. Let the Hall be adorn'd with Shepherds, Peasants, Neat-Herds, with Milk-Maids, Flocks of Sheep, and the like, in their respective Places, and with proper Attendants; as also Fowls, Fish, and the like:

V. Let the Stair-Case be set off with some admirable Monument or Building, either new or ruinous, to be seen and observed at a View passing up; and let the Ceiling over the Top-Stair be with Figures fore-shortened, looking down out of the Clouds, with Garlands, and Cornucopia's.

VI. Let Landskips, Hunting, Fishing, Fowling, Histories, and Antiquities, be put in the Great Chamber.

VII. Let the Pictures of the King, Prince, &c. or their Coats of Arms, be placed in the Dining-Room, forbearing to put any other Pictures of the Life, as not being worthy to be their Companions, unless at the lower End, two or three of the chief Nobility, as Attendants on their Royal Persons; for want of which, you may place some few of the nearest Blood.

VIII. In the inward, or withdrawing Chambers, put other Draughts of the Life, of Persons of Honour, intimate, or special Friends, or Acquaintance; or of Artists only.

IX. In Banqueting-Rooms, place chearful and merry Paintings, as of *Bacchus*, Centaurs, Satyrs, Syrens, and the like, forbearing all obscene Pictures.

X. Histories, grave Stories, and the best Works become Galleries, where any one may walk, and exercise their Senses in viewing, examining, delighting, judging, and censuring.

XI. Place Castles, Churches, or some fair Buildings in Summer-Houses, and Stone-Walks. In Terrasses, put Boscage, and wild Works. Upon Chimney-Pieces, only Landskips; for they chiefly adorn.

XII. Place your own, your Wife and Childrens Pictures, in your Bed-Chambers, as only becoming the most private Room, and your Modesty; least (says our Author,) if your Wife be a Beauty, some wanton Guest should gaze on't too long, and commend the Work for her sake.

XIII. In hanging Pictures, if they hang high above Reach, let them bend somewhat forward at the Top; because, otherwise, it is observed, that the visual Beams of your Eye which extend to the Top of the Picture, appear further off than those of the Foot.

DISTEMPER, in Painting, is the Working up of Colours with something else besides bare Water, or Oil; as if the Colours

are mixed with Size, Whites of Eggs, or any such proper glutinous or unctuous Substance, and not with Oil, then the Painting is said to be done *in Dislemper*, as the admirable Cartoons at *Hampton-Court* are.

DISTINCT BASE, in Opticks, is that Distance from the Pole of a convex Glass, in which Objects beheld through it appear *distinct*, and well defined, and is what is otherwise called the *Focus*.

DISTRIBUTION, in Architecture, as the *Distribution of the Plan*, is the dividing and dispensing the several Parts and Pieces, which compose the Plan of a Building.

Distribution of Ornaments, is an equal orderly placing of the Ornaments in any Member of Architecture.

DITRYGLYPH, in Architecture, the Space between two *Triglyphs*.

DIVERGENT, } in
DIVERGING Lines, } in Geometry, are such Lines whose Distance is continually increasing. Lines which converge one Way, diverge the opposite Way.

Divergent Rays, } in Opticks,

Diverging Rays, } are those Rays which issue from a Point of a visible Object, are dispersed, and continually depart from one another, according as they remove from the Object.

In this Sense, the Word is opposed to *Convergent*; which implies that the Rays approach each other; or to tend to the Centre, where, when they are arrived, they intersect, and if continued further, they become *diverging*.

Concave Glasses render the Rays *diverging*, and Convex ones *converging*.

Concave Mirrors make the Rays *converge*, and Convex ones *diverge*.

It is demonstrated in Opticks, that as the Diameter of a pretty large Pupil does not exceed two M. or one Fifth of a Digit. *Diverging Rays*, flowing from a radiant Point, will enter the Pupil, parallel to all Intents and Purposes, if the Distance of the Radiant from the Eye be four thousand Feet.

Diverging Hyperbola, is one whose Legs turn their Convexities towards one another, and run contrary Ways.

DIVIDEND, in Arithmetick, is the Number that is to be divided into equal Parts by another Number.

DIVISIBILITY is that Disposition of a Body whereby it is conceived to have Parts, into which it may actually or mentally be divided; or it is defined a passive Power, or Property in Quantity, whereby it becomes separable into Parts, either actually, or at least mentally.

Body is divisible *in infinitum*, i.e. you cannot conceive any Part of the Extension ever so small, but that still there may be a smaller.

There are no such Things as Parts infinitely small; but yet the Subtly of the Parts of several Bodies is such, that they very much pass our Conception. And there are innmmerable Instances in Nature of such Parts that are actually separated from one another.

Mr.

Mr. Boyle gives us several Instances: He mentions a Silken Thread that was three hundred Yards long, which weighed but two Grains and a half.

He also measured Leaf-Gold, and found that fifty square Inches of Leaf-Gold weighed but one Grain. Now if the Length of an Inch be divided into two hundred Parts, the Eye may distinguish them all; therefore there are in one square Inch forty thousand visible Parts; and in one Grain of Gold there are two Millions of such Parts; which visible Parts may be further divided.

DIVISION is one of the four great Rules of Arithmetick, being that whereby we find how often a less Quantity is contained in a greater, and the Overplus.

Division of Numbers, is in Reality only a compendious Subtraction: The Effect of it being to take a less Number from a greater, as often as it is possible, that is, as oft as it is contain'd therein. There are three Numbers contained in *Division*: *First*, That given to be divided, called the Dividend. *Secondly*, That whereby the Dividend is to be divided, which is called the Divisor. *Thirdly*, That which expresses how oft the Divisor is contained in the Dividend, or the Number resulting from the *Division* of the Dividend by the Divisor, called the Quotient.

DIVISOR, is the Dividing Number, or that which shews how many Parts the Dividend is to be divided into.

DODECAGON, a regular

Polygon, consisting of 12 equal Sides and Angles.

DODECAEDRON, in Geometry, is one of the regular *Platonic* Bodies, comprehended under 12 equal Sides, each of which is a *Pentagon*. Or,

A *Dodecaedron* may be conceived to consist of 12 quinquangular Pyramids, whose Vertices or Tops meet in the Centre of a Sphere, conceived to circumscribe the Solid, and of consequence they may have their Bases and Altitudes equal.

To find the Solidity of the Dodecaedron.

First, Find that of one of the Pyramids, and multiply it by the Number of Bases, viz. 12, and the Product will be the Solidity of the whole Body; or the Solidity of the whole Body may be found by multiplying the Base into one Third of its Distance from the Centre 12 Times: And to find this Distance, take the Distance of two parallel Faces, and the Half will be the Height: Or,

Multiply the Area of the Pentagonal Faces of it by 12, and then this latter Product of it by one Third of the Distance from the Distance from the Centre of the *Dodecaedron*, which is the same as the circumscribing Sphere.

The Side of a *Dodecaedron* inscribed in a Sphere, is the greater Part of the Side of a Cube inscrib'd in that Sphere, cut into extrem and mean Proportion.

If the Diameter of the Sphere be 1000, the Side of a *Dodecaedron* inscribed in it, will be .35682.

All *Dodecaedrons* are similar, and are to one another as the Cubes of their Sides; and their Surfaces are also similar, and are therefore as the Square of their Sides; whence, as .509282 is to 10.51462, so the Square of the Side of any *Dodecaedron* to its Superficies; and as .3637 to 2.78516, so is the Cube of the Side of any *Dodecaedron* to the Solidity of it.

Let ABCDEFGHIK be a *Dodecaedron*, each Side of which being 12 Inches, the solid Con-

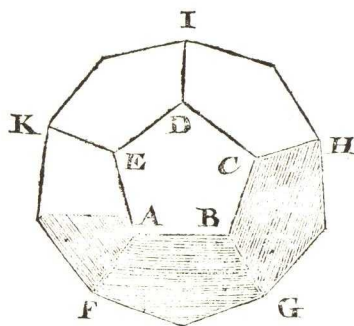
tent, and superficial Content is requir'd.

The Solidity of the *Dodecaedron* is compos'd of 12 Pentangled Pyramids, whose Vertices all meet in the Centre.

Therefore if we find the Solidity of one of those Pyramids, and multiply that by 12, that Product will be the Solidity of the *Dodecaedron*.

The Altitude of one of the Pentangled Pyramids will be found to be 13.36219.

The Perpendicular of the Pentagon will be 8.258292.



847.748760
30 half Sum

247.748760
60454.4

99099504
9909950
1238744
99099
1486

1103 48783 Content of one Pyramid.
12

13241.85396 the Solidity of the *Dodecaedron*.

If the Area of the Pentagon be multiplied by 12, the Product will be the superficial Content.

$$\begin{array}{r} 247.7487 \\ 12 \\ \hline 2972.98512 \end{array} \text{ the superficial Content.}$$

Example 1. If the Side of a *Dodecaedron* be 12 Inches, what is the Content solid and superficial?

$$\begin{array}{r} 7.663119 \text{ the tabular Number.} \\ 1728 \text{ the Cube of the Side.} \\ \hline 61304952 \\ 15326238 \\ 53641833 \\ 7663119 \\ \hline 13241.869632 \end{array} \text{ the solid Content, nearly the same as before.}$$

$$\begin{array}{r} 20.645729 \\ 144 \\ \hline 82582916 \\ 82582916 \\ 20645729 \\ \hline 2972.984976 \end{array} \text{ the superficial Content.}$$

By Scale and Compasses.

Extend the Compasses from 1 to 12, (the Side,) that Extent being turn'd three Times over from 7.63119, will at last fall up-

on 13241.86, &c. the solid Content.

And if you apply the same Extent twice from 20.645729, it will at last fall upon 2972.98, &c. the superficial Content.

Example 2. If the Side of an *Octaedron* be 20 Inches, what is the solid and superficial Content ?

.4714045 the tabular Number.
8000 the Cube of the Side.

3771.2360000 the solid content.
3.464102 the tabular Number.
400 the Square of the Side.

1385.640800 the superficial Content.

By Scale and Compasses.

Extend the Compasses from 1 to 20, and that Extent turn'd three Times over from .4714045, will at last fall upon 3771.236, the solid Content.

The same Extent turn'd twice over from 3 464, &c. will at last fall upon 1385.64, the superficial Content.

DOVE, in Architecture, a spherical Roof, or a Roof of a spherical Form raised over the Middle of a Building, as a Church, Hall, Pavilion, Vestible, Stair-Cafe, &c. by way of crowning.

Domes are the same that the *Italians* call *Couppola's*, and we *Cupola's*. *Vitruvius* calls them *Tholi*.

They are generally made round, or resembling the Bell of a great Clock; but there are some Instances of square ones, as those of the *Louvre*; and also some of them are in the Form of Polygons, as that of the *Jesuit's Church* in the *Rue St. Anthoine* at *Paris*.

Domes have commonly Columns ranged around their Out-sides, both for the sake of Or-

nament, and Support to the Vault.

DOORS, in Architecture, are Apertures in Walls, to give Entrance and Exit into and out of a Building, or an Apartment of it.

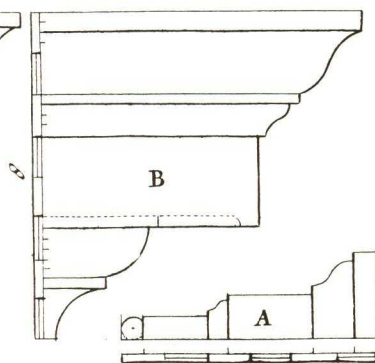
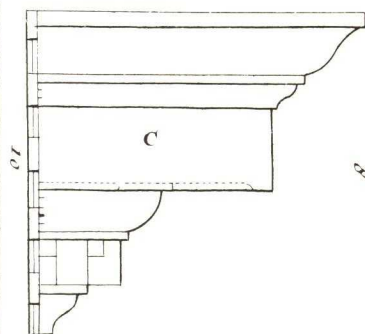
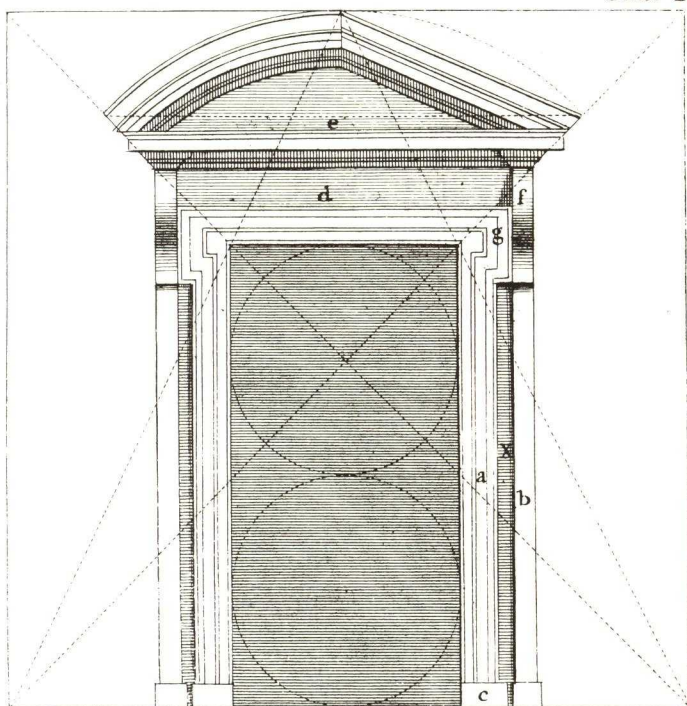
It is laid down as a Rule, that the *Doors* of an House be as few in Number, and as moderate in Dimensions as possible: For, in a Word, all Openings are Weak-nings.

Secondly, That they do not approach too near the Angles of the Walls, it being a very great Solecism to weaken that Part which should strengthen all the rest.

A Precept well recorded, but illy practised by the *Italians*, particularly at *Venice*.

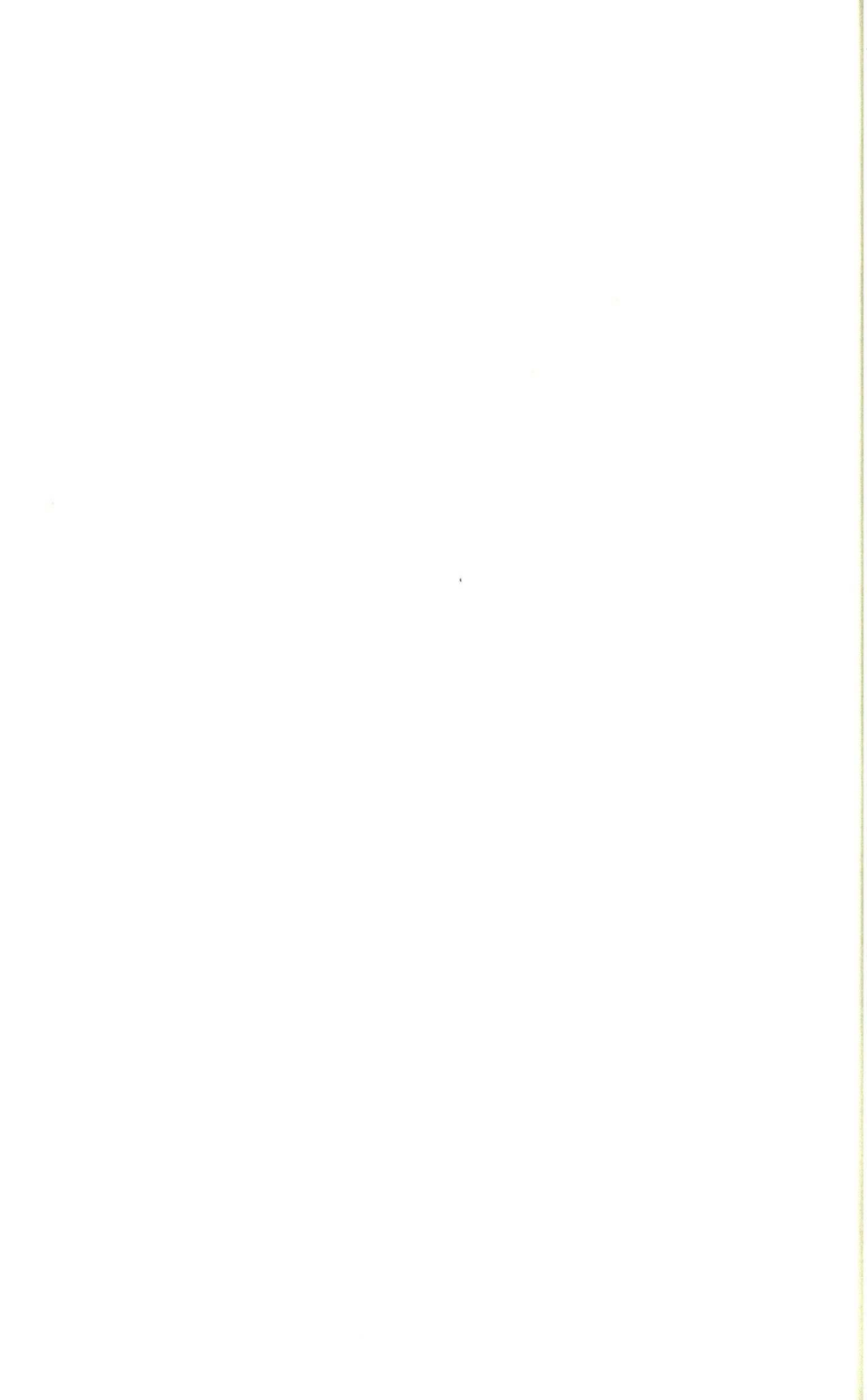
Thirdly, That the *Doors*, if possible, be placed over one another, that Void may be over Void, and Full over Full; which will be a great Strengthening to the whole Fabrick.

Fourthly, That, if possible, they may be opposite to each other, in such manner, that one may see from one End of the House to the other; which will not only be very graceful, but most convenient,



6

Tomb Sculpt.



venient, in respect that it affords Means of cooling the House in Summer, by letting the Air through the House; and by keeping out the Wind in Winter, which Way soever it fit.

Fifthly, 'Tis not only ornamental, but very secure, to turn Arches over *Doors*; which will discharge them, in great Measure, of the superincumbent Weight.

The Proportion of *Doors* is adjusted by that of a Man.

In large Buildings they must always be larger than in small; but should not be less than six Foot high in any, to admit a Man of just Stature erect And as the Breadth of a Man with his Arms placed a-kembo, is nearly subduple his Height, the Width ought never to be less than three Feet.

Some Architects give us these Dimensions following:

In small Buildings, the Breadth of the *Door*, four Feet, or four and a half; in middling Buildings, five or six; in large ones, seven or eight; in Chambers of the first Story, three and a half, three and three Fourths, or four: of the second, four, or four and a half; and of the third, five or six; in Churches, seven or eight; in Gates, nine, ten, or twelve. Hence their Height is easily determin'd, except for the Gates of Cities, which should only be four Fifths of their Breadth.

Palladio has an Observation, that the principal *Door*, or Entrance of an House must never be regulated by any certain Dimensions, but by the Dignity of the Person who is to live in it; yet to exceed rather in the more than the less is a Token of Ge-

nerosity, and may be excused with some noble Emblem, as that of the *Conte di Bevilacqua*, over his large Gate at *Verona*, where a little Disproportion had been committed, *Patet janua cor magis*.

As to the Price of *Doors*: Those that are made of plain, Whole Deal, and rabbeted, are for Stuff, Nails, and Workmanship, valued, as some Workmen say, at 3*d.* or 4*d.* the superficial Foot; the Workmanship only at 2*s.* or 2*s.* 6*d.* per *Door*.

Double Doors batten'd, or made Wainscot-fashion, may be worth 7*d.* the Foot for Workmanship and Materials, and 4*s.* or 5*s.* per *Door*, for Workmanship alone.

Folding Doors and Cases are usually valued at 20*s.* or 30*s.* per Pair; and *Balcony Doors* and Cases at the same Rate.

Ordinary Doors, without plaining, are usually valued at 1*s.* per *Door*, making and hanging up.

Architrave Door-Cases, in Brick Buildings, are worth, according to their Mouldings, a Penny an Inch, *i. e.* if the Breadth of the Moulding (from the Outside to the Inside of the Frame) be nine Inches, it is worth 9*d.* per Foot running Measure; if ten Inches, 10*d.* per Foot; and so either more or less, in Proportion.

Frontish Doors, in large Buildings, with their usual Ornaments, as Pilasters, &c. are worth (according to their Largeness and Variety of Workmanship included) from 3*l.* to 5*l.* 10*s.* or 20*l.* or more, per *Door*. See *BATTEN DOOR*.

M. Le Clerc says, when a little Door is made in the Front of

an ordinary, but regular Building, it should be raised to the just Height of the Windows that accompany it; but its Breadth must a little exceed that of the Windows, lest while it is adjusted to the rest of the Building, it appear ill-proportion'd in itself.

If it is desir'd to have the *Door* adorn'd with an Order of Columns, it must be raised higher.

A Geometrical Rule for a Door, or Window.

The Breadth being given, take it three Times for the Side of a Square, and draw the Diagonals, whose Interfection will be the Centre of the Pediment's Arch; then from the Top of the Pediment, draw Lines to the opposite Angles of the Square, and their Interfection with the Diagonals, is the Height of the *Door*.

The Breadth of the *Door* being divided into six, one is for the Breadth of the Architrave^a, one Third to the Space^x, two Thirds to the Pilaster^b; the Plinth^c is two Thirds high; the Height of the Kneel^g of the Architrave is twice its Breadth; the Height of the Frize^d is equal to the Breadth of the Architrave, and the Cornice^e one Fourth higher; the Length of the Truss^f is from the Top of the Frize to the Bottom of the Kneel. For the several Members, divide the Breadth of the Architrave^A into six Parts, giving half a Part to the Bead, one and a half to the first Face, half a Part to the small Ogee, two to the second Face, one to the Ogee, a half Part to the Fillet.

For the Projections, the first

Face is a half Part, the second Face one, and the Whole two.

For the plain Cornice^B, divide the Height into eight Parts, giving one and one Fourth to the Cavetto, one Fourth to the Fillet, one and one Fourth to the Ovolo, one Fourth to the Fillet, two to the Corona, three Fourths to the Cima Reverfa, one Fourth to the Fillet, one and a half to the Cima Recta, and a half Part to the Fillet. For the Projections, the Cavetto hath one and a half, the Ovolo two and a half, the Corona five and a half, the Cima Reverfa six and a half, and the Whole eight.

For the Dentil Cornice^C, divide the Height into ten Parts, giving one and one Fourth to the Ogee, one Fourth to the Fillet, one and a half to the Dentils, (whose Breadth is two Thirds of their Height,) one Fourth to the Fillet, one and one Fourth to the Ovolo, one Fourth to the Fillet, two and one Fourth to the Corona, three Fourths to the Cima Reverfa, one Fourth to the Fillet, one and a half to the Cima Recta, and a half Part to the Fillet. For the Projections, the Ogee hath one and a half, the Dentils two and a half, the Ovolo four, the Corona seven and a half, the Cima Reverfa eight and a half, and the Whole ten. See the Plate.

DORIC, in Architecture, is the second of the Five Orders; and is that between the *Tuscan* and the *Ionic*.

This Order seems the most natural and best-proportion'd of all the Orders, all the Parts of it being founded on the natural Position of solid Bodies.

Accordingly,

Accordingly, the *Doric* is the first and most antient of the Orders of Architecture, and is that which gave the first Idea or Notion of regular Building.

It was, indeed, more simple at its first Invention than it is at present; and when they came in After-Times to adorn and enrich it more, the Appellation of *Doric* was restrained to this richer Manner; and then they called the primitive simple Manner by the new Name of *Tuscan*.

Tradition delivers that *Dorus* King of *Achaia* having built a Temple of this Order at *Argos*, dedicated to *Juno*, caused it to be called *Doric*: Though some derive its Name from its having been invented or used by the *Dorians*.

Some Time after its Invention, it was reduced to the Proportions, Strength, and Beauty of the Body of a Man.

Hence as the Foot of a Man was judged the sixth Part of its Height, they made the *Doric* Column six Diameters high. After that they added another Diameter to it, and made it seven; which Augmentation seem'd to bring it nearer to the Proportion of a Man; the human Foot, at least, in our Days, not being exactly a Sixth, but nearly the Seventh of the Body.

The Characters of the *Doric* Order, as they are now manag'd, are the Height of its Column, which is now eight Diameters; the Frize, which is adorn'd with Triglyphs, Drops, and Metopes; its Capital, which is without Volutes; and its admitting of *Cymatiums*.

It has been already observed, that the Antients had two *Dorics*: The first of which was the more simple and massive, and chiefly used in Temples; the second, which was the more light and delicate, they used in Porticoes and Theatres.

Indeed, *Vitruvius* complains of the *Doric*, as being very troublesome and perplexing on Account of the Triglyphs and Metopes, so as to be scarce capable of being used, except in the Pycnostyle, by placing a Triglyph between each two Columns; or in the Aræostyle, by placing three Triglyphs between each Column.

The *Doric* is used by the Moderns on Account of its Solidity in large strong Buildings, as in the Gates of Cities and Castles, the Outsides of Churches, and other massy Works, in which Delicacy of Ornaments would be unsuitable.

The most considerable antient Monument of this Order, is the Theatre of *Marcellus* at *Rome*, the Capital, the Height of the Frize, and Projecture of which, are much smaller than in the modern Architecture.

Vignola adjusts the Proportions of the *Doric* Order, as follows: He divides the whole Height of the Order, without the Pedestal, into twenty Parts, or Modules; one of which he allows to the Base, fourteen to the Shaft or Fust, one to the Capital, and four to the Entablature. The particular Proportions of the several Parts and Members may be seen under their respective Articles.

The DORIC ORDER delineated by equal Parts, instead of Modules and Minutes.

The Height of the Pedestal being two Diameters and one Third, is divided into four, giving one to the Base, whose Plinth is two Thirds thereof; the other Part is divided into seven, giving four to the Torus, one to the Fillet, and two to the Hollow. The Breadth of the Die is a Diameter and one Third. The Projection of the Base is equal to its Height, and the Fillet hath four of these Parts. The Height of the Cornice is half the Base, being one Eighth of the whole Height; and is divided into nine, giving two to the Hollow, one to the Fillet, five to the Corona, and one to the Fillet; the Projection of the Hollow is three of these Parts, the Corona six, and the Whole seven.

Base of the Column.

The Height is half a Diameter, and is divided into six, giving two to the Plinth, one and a half to the lower Torus, one Fourth to the Fillet, one to the Scotia, $\frac{1}{4}$ to the Fillet, and one to the upper Torus. The Fillet above the Torus is equal to the others, and is Part of the Column. The Projection is two of these Parts, and one Third thereof is for the upper Fillet, two Thirds to the upper Torus, and the Fillet under it, is perpendicular to the Centre.

For forming the Scotia, divide the Height into three, as in

the Scheme, and on the Line that separates the one Part above from the two Parts below, and perpendicular to the Fillet, is the Centre for the first Quarter-Sweep, and the same Distance forwards, on the Line, is the Centre for the other Quarter; and is also the Projecture of the lower Fillet.

The Diminishing of this Column is one Eighth of the Diameter. The Height of the Capital is half a Diameter, and is divided into nine, giving three to the Frize of the Capital, one to the Fillets, which are three, and are equal, two to the Ovolo, two to the Abacus, and one to the Ogee^b and Fillet, which is one Third.

For the Projections, the Fillets have one of these Parts, the Abacus three, and the Whole four.

The Height of the Architrave is half a Diameter, and is divided into six Parts, giving two to the first Face, two to the second, one to the Bells^c and Fillet, which is one Third, and one to the Band at top. The Projection is equal to the Band.

The Frize is in Height three Fourths of the Diameter, and the Triglyphs^a are in Breadth half a Diameter; which are divided into six, giving one to each of the Channels, half a Part to each Half-Channel, and one to the Spaces between the Channels.

The Projection from the Naked of the Frize is three Fourths of a Part, and the Spaces, or Metopes, between the Triglyphs, ought to be equal to the Height of the Frize.

The Height of the Cornice is three Fourths of the Diameter, and is divided into nine, giving one to the Cap of the Triglyph, one to the Hollow and Fillet, which is one Sixth, one to the Ovolo, one to the Mutule and Fillet under it, which is equal to the other, a half Part to the Cap of the Mutule and Fillet, which is one Third, one and three Fourths to the Corona, three Fourths to the Cima Reversa, one Fourth to the Fillet,

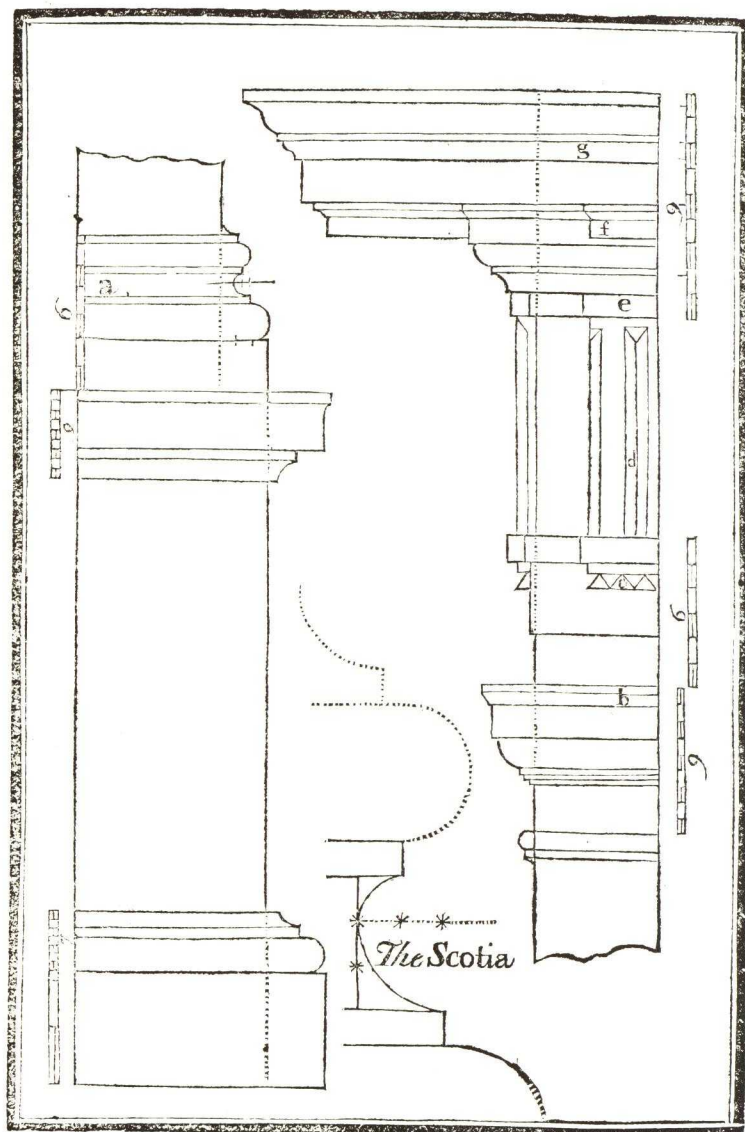
one and one Fourth to the Cima Recta, and a half Part to the Fillet.

For the Projections, the Cap of the Triglyph hath one of these Parts, the Hollow one and three Fourths, the Ovolo two and three Fourths, the Mutule eight and three Fourths, the Corona nine and three Fourths, the Cima Reversa ten and three Fourths, and the Whole twelve Parts.

DORMER,

D E

D E



D R

DORMER, $\int$ in Architecture, **DORMANT**, $\int$ tecture, is the Window made in the Roof of a House, or above the Entablature, being raised upon the Rafterers

Dormers are commonly rated at so much *per Piece*.

Dormant-Tree is a Name given by Workmen to a great Beam lying cross a House, commonly called, a *Summer*

Dormant-Tiles. See **TILES**.

DORMITORY, a Gallery in Convents or Religious Houses, divided into several Cells, in which the Religious sleep or lodge.

DOUCINE, in Architecture, is a Moulding or Ornament on the highest Part of the Cornice, in the Form of a Wave, half convex, and half concave.

The *Doucine* is the same as a Cymatium, or Gula.

DOVE-TAILING, in Carpentry, is a Manner of fastening Boards (or other Timber) together, by letting one Piece into another, in the Form of the Tail of a Dove. It is the strongest of the Kinds of Jointings or Assemblages, wherein the Tenon, or Piece of Wood which is put into the other, goes widening to the Extreme; so that it cannot be drawn out again by reason the Extreme or Tip is bigger than the Hole.

It is called by the *French*, *Queue d'Aronde*, i. e. *Swallow-Tail*; which Name is also used by the *English* themselves in Fortification

DRAG. A Door is said to *drag*, when in opening or shutting, it hangs or grates upon the Floor, or Cell.

D R

DRAGON BEAMS are two strong Braces or Struts which stand under a Brest-Summer, meeting in an Angle upon the Shoulder of the Kingpiece.

DRAPERY, in Sculpture and Painting, the Representation of the Garments or Clothing of human Figures. It includes not only Garments, but Tapestry, Hangings, Curtains, &c.

DRAUGHT, $\int$ in Architecture, **DRAFT**, $\int$ ture, is the Figure of an intended Building described on Paper; in which is laid down, by Scale and Compasses, the several Divisions and Partitions of the Apartments, Rooms, Doors, Passages, Conveniencies, &c. in their due Proportion to the whole Building.

It is customary, and also exceedingly convenient for any Person, before he begins to erect a Building, to have Designs or *Draughts* drawn upon Paper or Vellum, wherein the Ichnography or Ground-Plot of every Floor or Story is delineated or represented, as also the Form or Fashion of each Front, with the Windows, Doors, Ornaments. &c. in an Orthography, or Upright.

Sometimes the several Fronts, &c. are taken and represented in the same *Draught*, to shew the Effect of the whole Building, which is called a *Scenography* or *Perspective*.

But this not being easily understood, except by those who understand the Rules of *Perspective*, therefore it will be more intelligible to the several Workmen, to have a *Draught* of each Front, in a particular Paper by itself;

itself; and also a *Draught* of the Ichnography or Ground-Plot of each Floor or Story; in a Paper by itself; because oftentimes the Contrivance and Conveniencies of one Story differ from those of another, either as to the Largeness of the Chimneys or Divisions of the Rooms, some being larger in one Story than another, &c.

All which Things being well considered and drawn on Paper before the Building is begun; these *Draughts* will be a great Guide to the Workmen, and save them a great deal of Time in contriving their Work; and, besides, there will be no need of Alterations, or pulling the Building to Pieces after 'tis begun; which, besides the Hindrance of the Procedure, makes the Building lame and deficient; nothing being so well done, when 'tis put up, and pull'd down, and set up again, as if it were done at first.

To draw any Object in its Outlines as exact as the Life, or Nature.

Take a Sheet of the thinnest, or whitest brown Paper, and brush it over with Oil of Turpentine, which will immediately render it transparent and then put the Paper to dry in the Air; when it is dry, strain it upon a Frame, and fix it against any Object you design to draw, as an House, &c. then just before it place a Piece of Wood with a Hole in it, fit for one Eye to look through; and as you meet any Outlines of the Object you desire upon the transparent Pa-

per, trace them over with a Pencil, so will you be sure you cannot err; for there will be nothing but just Proportion, and a true Representation of Nature.

To make this still of more Elegancy, observe the Tracing of your *Draughts*, where the Shades are, and mark them with your Pencil; for all the Art in the World can never dispose the Shades so regularly, as one may touch by this Method: But the Shades must be done quickly after the Outlines are drawn, and not at different Times, because every Instant the Sun changes them.

In this too, observe, that in certain Objects, you will have fainter, stronger, and yet more dark Shades; and in your Remarks of them, take such Memorandums, as may direct you how to finish them, with *Indian Ink*, or other Colour, when you fit down to compleat your Work.

The best Way is to prepare three Shells or Gallipots of *Indian Ink* mixed with common Water, before you attempt to trace out your Object, viz. one of a very faint Black, the next of a middling Black, and the other of an intense Black: Number them 1, 2, 3, from the lightest to the darkest; and as you make your Observation on the Shades of your Object, mark upon your *Draught* the same Numbers, as they happen to appear; so that afterwards you may finish with Certainty.

Again, it is necessary in the drawing of any Thing after this Manner, to observe that the
Lines

Lines on the shady Side should be thinner, in Proportion to the Light that falls upon them.

As for Example: In the darkeſt Part a Line may be of that Thickneſs, in the next Part ſomewhat thinner, and in the other thus; unleſs in Things of a great Diſtance hardly to be underſtood, or ſo faint as hardly to be perceived thus; a mere Shadow, as it were.

Some have been guilty of a great Fault, though they have taken the Outlines very exact, by making all their Lines of an equal Thickneſs.

If an Object be repreſented at a great Diſtance, as half a Mile, or two Miles off, and the Drawing be as ſtrong in that Part of the Picture, as if it was next the Eye, or not ten or twenty Feet from the *Draughts-Man*, it would not appear pleaſant or natural to the Eye.

A Man muſt not be expreſſ'd with Buttons on his Coat at a Mile's, &c. Diſtance, no more than they muſt be omitted in a Perſon ſo near the Eye, as ten or twenty Feet: Though this has inadvertently been done by ſome that paſſed for great Men: Nor a Capital, &c. with Carvings and Mouldings, &c.

And the Shades, in thoſe diſtant Appearances, muſt be in Proportion to the Strength of the Objects as they appear to us, *i. e.* imperfect.

Three or four well-directed Touches of the Pencil on the ſhady Side, will repreſent a Figure at the Diſtance we can diſcern it, as lively as ſome Hundreds will near the Eye.

The tranſparent Paper, before mention'd, is alſo of another Uſe; for if it be laid upon any Picture or Print, all the Lines may be ſeen through it; and then you may draw or copy it with the greateſt Pleaſure.

You will then, if the Pictures be done by a good Maſter, ſee which Lines are ſtrong, and which tender or ſoft, and imitate them.

There is yet another Way to take Views and Landſkips, which ſome prefer to the tranſparent Paper, that is, either with white, or black Tiffany or Lawn ſtrained upon a Frame, and uſed in the ſame Manner as the Paper, excepting that the Black Lead Pencil is uſed to the Paper, on the Tiffany and the Lawn, Charcoal, finely pointed, and very ſoft, is uſed; but on the black Tiffany white Chalk of the tenderſt Sort.

How to bring theſe Drawings to Uſe, and to copy from Prints, Paintings, &c.

If you draw upon tranſparent Paper, to take a *Drawing* from it regularly, get a Piece of Paper of the ſame Size, and rub on one Side of it ſome Powder of Black Lead, till it is well and equally black'd, and ſo well rubb'd, that a Touch of a Finger will hardly be tinged with it.

Then take the *Drawing* you have made, or Print, and lay the black'd Paper under it, with the black'd Side downwards, upon a Piece of white Paper, and pin the three together, in two

or three Places; take then a Pin or Needle a little blunt at the Point, and trace it over the Outlines of your Picture, which, with a little Pressing, will direct the black Paper to impress the undermost white Paper, so as to receive every Stroke you draw.

When this is done, you must with a Black Lead Pencil, correct what Errors you find, and slightly clean the *Draught* new made, with some Crumbs of stale Bread.

Black Lead Pencils, that are tolerably good, are difficult to be got; if we find a good Piece of Lead in the Beginning, when it has been used an Inch or two, the rest generally proves hard, gritty, and full of Knots.

'Tis a great Pleasure to a *Draughts-Man* to work with a good Pencil, and as great a Plague to work with a bad one.

As for *Draughts* drawn on Tiffany, or Lawn, lay them only on one Paper, *i.e.* that which is drawn with Charcoal, on white Paper, and that drawn with Chalk on black or blue Paper; then giving each of them a Knock or two with an Hammer, the Charcoal, or the Chalk, will fall through them upon the Paper directly in the Lines they were drawn, and give you the true Representation of the Object you drew from the Life: Upon the black Paper, you will see it in white Lines; and on the white in black.

Then you are to strengthen these Shadows of *Drawings* with your Black Lead Pencil, or

Chalk, or Red Oker, on the Sheets of Paper where they have made their Marks, otherwise the Lines will be easily rubb'd out.

But you must take care that this Amendment be made suddenly, for these tender *Draughts* will soon vanish, if Care be not taken to strengthen them immediately. Begin first at the Bottom of the *Drawing*, that you may not rub out the faint Lines by strengthening the upper Part.

Another Method, is to take a thin Piece of Paper, and hold it against a Glass Window, especially at such a one as is fast'd; for the Interruptions of the Lead, in the finaller glaz'd Windows, will hinder Part of the Prospect: The Point is to draw what you see from the Glass, and then the Black Lead Pencil is to be used as before directed.

There is still another Way, which may be more easy to the Hand or Arm of a Person not accustomed to drawing upon Paper or Lawn placed upright; which is, by the Use of a portable *Camera Obscura*: Though to help the first one may hold a Baguette, or such a Stick, in the Left Hand, as the Oil-Painters do to rest the Right Hand upon; or have some other Rest made for the Right Hand, as may be screw'd up and down at one's Pleasure.

But there is this Difference still by drawing a Piece of Perspective, or View on a transparent Paper or Lawn, placed upright against any Object, that such a Piece will take in more of the View or Object, and
from

from a greater Distance than the portable *Camera Obscura* will.

However, as the portable *Camera* will at first be most easy to the Arm of the Beginner, by reason that the Objects appear upon an Horizontal Plane, such as a Table, the Hand will have a more proper Rest, and more readily follow the Lines represented on the Plane with Exactness.

Indeed, such a portable *Camera* is of some Expence; and such as can afford it, may have them of any Price, from 30 s. to 5 l. apiece, as they please, of Mr. John Fowler Mathematical Instrument Maker, in *Switzers-Alley*, near the *Royal Exchange*.

What will make the Differences in the Prices, will be the Largeness of the Sizes of the Glasses which lie horizontally, and receive the Objects which we are to trace out with the Pencil. The smaller of these Glasses may be perhaps four Inches square, and the larger fifteen Inches.

On such Glasses, you will have the exact Representation (smaller or larger, according to the Bigness of the Machines) of the Objects they are pointed or directed to, each one adorn'd with the natural Colours agreeable to the Point of Distance, stronger near the Eye, and gradually declining, as the Objects are more remote from it: The Shades of the several Colours are in this Way express'd in a very lively Manner.

A few Lessons, with good Consideration, will be of good Information, not only to a young

Beginner, but to a Master of the Pencil.

But still to advance the Knowledge and Use of this portable *Camera*, I suppose, that instead of the Glasses, which receive the Objects spoken of, there should be placed Frames of transparent Paper, to receive the Objects that are to be taken, upon which the Pencil may still be used with greater Freedom.

A Dozen or two may be had with each *Camera*; and one Frame will serve for as many Papers as you please to strain upon it, if a Person has Patience to paste them on.

There is also another Way of drawing Objects in the *Camera Obscura* Way; which is by making a Room as dark as may be, only leaving an Hole in one of the Window-Shutters, as low as possible, to receive an Ox-Eye Glass, as it is called; which is sold at the Mathematical Instrument Makers.

This turns in a Socket, so as to direct every Object, within a certain Reach, to a Sheet of Paper; so that you may draw them in great Perfection; but they all appear revers'd, or the wrong End downwards: However, they are in as exact Proportion and Beauty as those represented in the former.

In this Case, however, 'tis not more difficult to draw, or rather copy the several Things that are seen upright on the Frames of transparent Paper, Lawn, or Tiffany; for to trace Lines, will be done as easily one Way as the other.

And though the Objects falling on the Sheet of Paper, will,

while they are drawing, be reversed, 'tis but turning the Sheet of Paper upside-down when they are done, and the *Drawing* will be right to the Eye.

When this is shewn by Way of Curiosity, to those who are unacquainted with the Reasons why the Images represented on a Sheet of Paper appear upside-down, it would not have so desirable an Effect, as if they should be viewed in their natural Situation: But to obviate this Difficulty, let the Sheet of Paper, which is to receive the Objects, be placed against the Back of a Chair, and let them look on the several Objects represented on the Paper over the Back of the Chair, and it will set them upright to the Eye.

This Way of bringing them to rights, is thought on but by very few, tho' at the first Proof every one will wonder that he did not find it sooner.

Thus far is shewn how one may copy either a Print, *Drawing*, or Piece of Painting; or even make an exact Representation from the Life.

But I shall yet add, concerning the taking off of Prints or *Drawings*, a Method or two, which are easy or diverting, not before mentioned.

The one is, prick with a Pin any Out-Lines of a Print or *Drawing* you have a mind to copy, and then lay the said Paper on a Sheet of Paper; then take a Powder Puff, or a Tuft of Cotton, and dip it now and then in Charcoal Dust, or red Chalk Dust, and beat it over the prick'd Lines through the Picture, re-

newing it with Dust by frequent dipping; and then you will have full Directions marked on your Cloth or Paper, sufficient to finish a just *Drawing*.

Another Way there is to make an Impression from the Print or Picture, which shall give a just Copy of it. This is of great Use when we would carry every Stroke of the Engraver along with it.

It will indeed fully the Print, though not very much, if it be done with Care: Which may be perform'd in a few Minutes Time, when the *Drawing* of it with every Stroke the Engraver has made, would cost you whole Hours, nay, Days.

To do this, take some Soap, either of the white or green Sort; mix this with Water, till near the Consistence of a Gelly; wet the Paper you would have to receive the Impression from it with a wet Sponge, then lay it on the Print, and cover all with two or three Pieces of dry Paper, and rub it very hard all over with any Thing that is very smooth and polish'd; and the wetted Paper will have the reverse of the Print you rubbed it upon, with every distinct Line in the Original, if it has been equally rubbed.

To take a Drawing with fix'd Ink.

Take a thin Sheet of Paper, and rub it all over with fresh Butter, as equally as possibly; then dry it well by the Fire, and rub the buttered Side with Carmine, till 'tis all equally coloured; or else rub it over with Lamp-Black, or with Black-Lead

Lead Powder, or with blue Bice finely ground; take Care in the rubbing on any of these, that the Colour will not come off by a very slight Touch of the Finger, and it will be fit for your Work.

When you have chosen a Print or Design that you would copy, lay the coloured Side of your buttered Paper upon a Piece of clean Paper, and your Print upon the buttered Paper; and then with a fine Pin or Needle, blunted a very little at the Point, trace the Out-Lines of your *Drawing* carefully, and you will have a good Copy of it upon your white Paper, which may be touch'd up afterwards with Crayons of the like Colour.

Short Rules for Drawing in Perspective.

Many are deterred from applying themselves to *Drawing*, by the Apprehension of the Time it will take up to render themselves Masters of Perspective, and from being frightened at the Difficulties they conceive are in the Study; particularly imagining, that one must be first well grounded in the mathematical Sciences; but for the Encouragement of such Persons, I shall lay down in the following Lessons how to lay any Plan in Perspective, and raise Pillars or Buildings, according to their proper Distances.

LESSON I.
Of the Plan.

Suppose we have a square Piece of Pavement, as in Fig. I. consisting of 25 Pieces of Marble, each a Foot square, it must

be measured exactly, and laid regular down upon Paper. You may likewise, for your better Observation, mark every other Stone or Marble black; which will better inform you how every particular Square will appear when we have a true perspective View of them; or else you may number one, and when the following Lesson is done, number those in the perspective Plan with the same Figures as are marked on the first Plan.

LESSON II.

Of laying Figure I. in Perspective.

It is to be understood in Perspective, that there are two Points to be considered; the first we call the *Point of Sight*, that is, which relates to every Thing in our View from the Place where we stand: And it matters little where we stand to take our View; for the Perspective will still be true, according to the Appearance of the Plan to our Eye, if we stand at a Corner, or in the Middle, or at any Point. The Method I shall prescribe presently, will lay our Plan justly before us as it will appear.

The other Point is called the *Point of Distance*, because it governs the Distances and Proportions of every Thing we can truly see of the Plan, in whatever Position we happen to be.

At A you see the Plan of Fig. I. This is divided into Squares, as mentioned in that Figure; the three at the Bottom marked BCD in both *a* the Plan A, marked 1,2,3,4, are those which are marked in Perspective with the same Numbers.

Now to lay your Plan in Perspective, fix your Point of Sight, as you observe in the Figure, or more or less to the Right or Left, as you think proper; then draw the Line KK parallel to, and at what Distance you will from the Line LL; then raise a Line on each Side from L to K, to form the Figure you see as a Frame to your Picture; then draw a Line from the Corner of K, which is the Point of Distance to L, and this Line will regulate your Work. Then draw Lines from the Squares of your Plan to the Point of Sight, as exactly as possible; and wherever your Line of Distance cuts those Lines, which are drawn from the Square of your Plan to the Point of Sight, that marks where your Square in Perspective ought to be; then draw Lines parallel to the Line LL, where the Line of Distance cuts, and that will give you a true Figure of every Square. So D in the perspective Plan, answers to D in the measured Plan, and 1, 2, 3, 4, answers to the others in the same.

When you have done this, the next Rule you are to know, is how to raise Pillars, Trees, Houses, or any other Bodies, according to their respective Heights, at different Distances and Proportion on the Plan you have laid down.

How to raise Pillars, or any Bodies of a certain Proportion in Perspective. See Fig. III.

You have now your Plan measured out in Perspective into

Squares of a Foot; one of these Squares in this Lesson serves for the Base or Bottom of a Pillar a Foot thick.

This Figure III. is exactly of the same Dimensions of the Plan laid in Perspective at Fig. II.

First mark the Line LK in equal Proportions, by the same Scale of the ground Plan, Fig. II. as *a, b, c, d*, which are so many Feet in Height; and they standing on the Base of the first Figure, are Uprights not in Perspective: Then draw a Line parallel with L 1, from Number 4, which gives you the Front of the Body you are to raise; if it is to be only three Feet high, draw a Line cross from Number 4, and that determines the Height, which you will then find to be a Foot wide, and three Feet high by Measure: Then from the Top of the Line 4, draw a Line with a Black-Lead Pencil to the Point of Sight; and raise another Line from 3 parallel to the Line 4, till it touches the penciled Line passing from 5 to the Point of Sight; which gives you the Side Appearance of the Column or Body, as you will see it from the Place where you stand, [the Line from Point 3 should be drawn with a Pen, because it is to remain;] then with a Pencil draw a Line from C to the Point of Sight, which will determine the other Line, to make the Shape on the Top of the Column: And then raise a Line parallel with L 1, with a Pencil from the Point, till it touches the Line from C to the Point of Sight; then draw a parallel Line to C 5, at 6, 7, and you

Fig. 1.

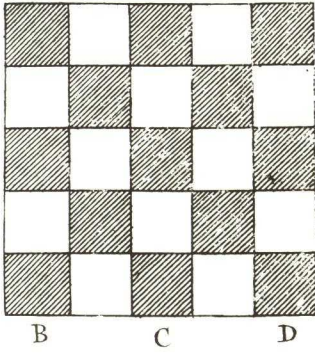


Fig. 3.

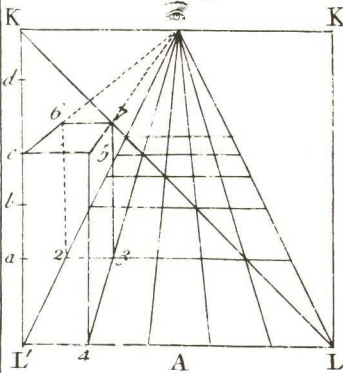


Fig. 2.

Point of distance Point of Sight

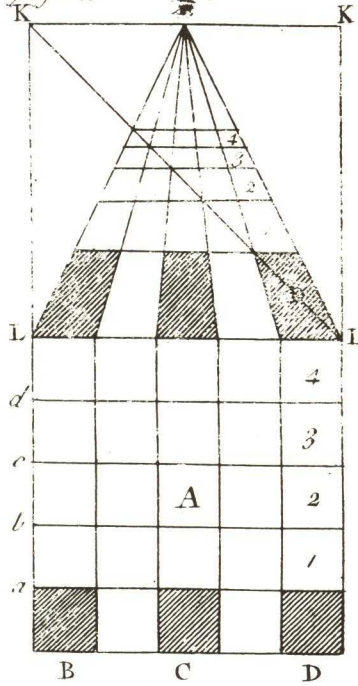
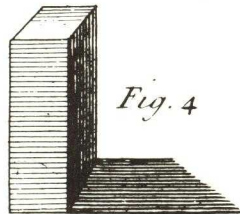


Fig. 4.





you will have the Square at the Top of the Pillar or Column, as you can observe it from the Place where you stand, which is supposed to be at A. [You must remember, that the Line drawn from 2 to 6, is only an imaginary Line, to be rubbed out; for it cannot be seen from the Place where you stand, and therefore must not appear in the *Drawing*; but you should not leave it out, because it shews you where to regulate the Top of the Column, and teaches you to place your Column upon its Base with Certainty.]

By this Means you may see Front, and one Side of your Column: And the Line from 1 to 2 must also be rubbed out, because it can't be seen.

Then finish your Column only with the Lines

From 1 to C	From C to 5
From 4 to 5	From 6 to 7, and
From 3 to 7	From 1 to 4.

And it will be drawn without any Imperfection, and appear as follows in Fig. IV.

When this is done, you may place another Column on any one of the Squares erected in the same manner, observing to sling your Shades all on one Side, and then you cannot err: But especially mind where the dotted Lines are in Fig. III.

DRAUGHT COMPASSES, are *Compasses* with several moveable Points, to draw fine *Draughts* in Architecture.

DRAW-BRIDGE is a *Bridge* made to draw up, or let down, as Occasion serves, before the Gate of a Town or Castle: And

they are made after several Manners; but the most common are made with Plyers twice the Length of the Gate, and a Foot in Diameter.

The inner Square is traversed with a Cross, which serves for a Counterpoise; and the Chains which hang from the other Extremities of the Plyers, to lift up or let down the *Bridge*, are of Iron or Brass.

DRIP, in Architecture. See **LARIMER**.

Drips are also used in Building for a certain kind of Steps, made on flat Roofs to walk upon; a Way of Building much used in *Italy*, where the Roof is not made quite flat, but a little raised in the Middle with *Drips*, or Steps, lying a little to the Horizon.

DROPS, in Architecture, an Ornament in the *Doric* Entablature, representing *Drops*, or little Bells, immediately under the Triglyphs.

DUPLA RATIO $\frac{2}{1}$ i. e. *Double DUPL* $\frac{2}{1}$ *Ratio*, in Architecture, is where the antecedent Term is *double* the Consequent; or where the Exponent of the Ratio is 2; thus 6 : 3 is in a *Duple Ratio*.

SUB-DUPLE, or *Double Sub-Duple Ratio*, is where the consequent Term is *double* the Antecedent, or the Exponent of the Ratio is $\frac{1}{2}$; thus 3 : 6 is a *sub-duple Ratio*.

DUPLICATE Ratio ought to be well distinguished from *Duple*.

In a Series of Geometrical Proportions, the first Term to the third is said to be in a *Duplicate Ratio* of the first to the second,

second, or as its Square is to the Square of the second : Thus 2. 4. 8. 16. the Ratio of 2 to 8 is *Duplicate* of that of 2 to 4, or as the Square of 2 to the Square of 4; for which Reason, *Duplicate Ratio* is the Proportion of Squares, as *Triuplicate Ratio* is of Cubes, &c. And the Ratio of 2 to 8, is said to be compounded of that of 2 to 4, and of 4 to 8.

DUPLICATION, i. e.

Doubling, in Arithmetic and Geometry, is the multiplying a Quantity discrete, or continued by two.

The Term is chiefly used of the Cube, as the *Duplication of the Cube*, which is a famous Proposition that the Geometricians have sought this 2000 Years.

The *Duplication of a Cubic*, is to find the Side of a Cube that shall be equal in Solidity to a Cube given.

This has been attempted by several geometrically; but it is in vain to pretend to it, for it cannot be done without the Solution of a cubick Equation; and so a Cornick Section, or some higher Curve, must be used for determining the Problem.

DYE, in Architecture, is any square Body, as the Trunk or notch'd Part of a Pedestal; or it is the Middle of the Pedestal, or that Part included between the Base and the Cornice; or is so called, because it is often made in the Form of a Cube or *Dye*.

Dye is also used for a Cube of Stone, placed under the Feet of a Statue, and over its Pedestal, to raise it, and shew it the more.

DIPTERE, in the antient
DIPTERE § Architecture,
was a Kind of Temple encom-

passed with a double Row of Columns; and the *Pseudo Dyptere*, or *False Dyptere*, was the same, only that this was accompanied with a single Row of Columns, instead of a double Row,

E A

EAGLE, in Architecture, a Figure of that Bird, antiently used as an Attribute or Cognizance of *Jupiter* in the Capitals and Friezes of the Columns of Temples consecrated to that God.

EAVES, in Architecture, is the Margin or Edge of the Roof of an House; being the lowest Tiles, Slates, or the like, that hang over the Walls, to throw off Water to a Distance from the Wall.

Eaves-Lath, is a thick feather-edg'd Board, generally nailed round the *Eaves* of an House for the lowermost Tiles, Slates, or Shingles to rest upon.

Eaves-Laths are commonly sold for three Half-pence or Two-pence per Foot, (running Measure,) according as they are in Goodness.

ECCENTRICK, in Geo-
EXCENTRIC § metry,
a Term apply'd where two Circles or Spheres, though contained in some Measure within each other, yet have not the same Centre, and of consequence are not parallel in Opposition to Concentrick, where they have one and the same common Centre, and are parallel.

ECCENTRICITY

ECCENTRICITY } is the
EXCENRICITY } Distances between the Centres of two Circles or Spheres, which have not the same Centre.

ECHINUS, in Architecture, is a Member or Ornament near the Bottom of the *Ionic*, *Corinthian*, and *Composite* Capitals, which the *French* call *Quart de Rond*, from its circular Form or Contour; and the *English*, *Quarter Round*, or *Boulton*; the *Italians* call it *Ovolo*, from *Ovum*; and the *French*, *Ove*, from the *Latin*, *Ovum* an Egg; and thence the *English* call it *Eggs and Anchors*. See ANCHOR.

The *Greeks* call it *ἐχίνος*, a Chestnut, from the Egg's being encompassed with a Cover something resembling a Chestnut cut open.

ECHO, in Architecture, is a Term applied to certain Kinds of Vaults and Arches, most commonly of elliptical and parabolical Figures, used to redouble Sounds, and produce *artificial Echoes*.

The Jesuit *Blanc*, in his *Echometry*, at the End of his first Book of the *Sphere*, teaches the Method of making an *artificial Echo*.

Vitruvius relates, that in divers Parts of *Greece* and *Italy*, there were brazen Vessels artfully ranged under the Seats of the Theatres, to render the Sound of the Voices of the Actors more clear, and make a Kind of *Echo*; by which Means, every Person of that prodigious Multitude who assisted at the Spectacles, might hear with Ease and Pleasure.

Echo is a Sound reflected or reverberated from a solid concave Body, and so repeated to the Ear.

The *Peripateticks*, who imagined Sound to be I know not what Species, or Image of the sonorous Body impressed on the adjoining Air, account for *Echo* from a Resilition or leaping back of the Species, caused by its meeting some Obstacle in the Way.

But modern Naturalists, who know that Sounds consist in a certain Tremor or Vibration in the sonorous Body, communicated to the contiguous Air, and by that Means to the Ear, give us a more consistent Account of *Echo*.

For 'tis evident, that a tremulous Body, striking upon another solid Body, may be repelled without destroying or diminishing its Tremor; and of consequence, that a Sound may be redoubled by the Resilition of the tremulous Body or Air.

But a simple Reflection of the sonorous Air is not enough to solve the *Echo*; for then every plain Surface of a solid Body, as being fit to reflect a Voice or Sound, would redouble it; which, as is found by Experience, does not hold.

Therefore it should seem, that a kind of Concavement or Vaulting were necessary to produce an *Echo*, in order to collect; and by collecting, to heighten and increase, and afterwards to reflect the Sound; as it is found is the Case in reflecting the Rays of Light, where a concave Mirrour is required.

In Effect, as often as a Sound strikes on a Wall perpendicularly, behind which, is any Thing of an Arch, or even another parallel Wall, so often it will be reverberated, either in the same Line, or other adjacent ones.

Therefore it is necessary, in order that an *Echo* be heard, that the Ear be in the Line of Reflection; and in order that the same Person may hear it echo, who made the Sound, it is necessary, that he be perpendicular to the Place which reflects it. And as for a tautological or manifold *Echo*, it is necessary, that there be a Number of Walls and Vaults, or Cavities, either placed behind each other, or fronting each.

A single Arch or Concavity, &c. can scarce ever stop, and reflect the Sound; but if there be a convenient Disposition behind it, Part of the Sound, that is propagated thither, being collected and reflected as before, will present another *Echo*; or if there be another Concavity opposed at a due Distance to the former, the Sound reflected from the one upon the other, will be toss'd back again upon this latter, &c.

The Bishop of *Leighs*, &c. has well consider'd many of the Phenomena of *Echo*.

He remarks, that any Sound falling either directly or obliquely on any dense Body of a smooth Superficies, whether arched or plain, is reflected more or less.

He says, the Surface must be smooth, or else the Air by Reverberation will be put out of

its regular Motion, and the Sound thereby broke or extinguish'd.

He likewise adds, that it echoes more or less, to shew that when all Things are, as before described, there is still an *Echoing*, though it be not always heard, either because the direct Sound is too weak to be beat quite back again to him that made it, or that it does return to him, but so weak, that it cannot be discern'd; or else that he stands in a wrong Place to receive the reflected Sound, which passes either over his Head, or under his Feet, or on one Side of him, and which therefore may be heard by a Man who stands in the Place where the reflecting Sound will come, provided no interposed Body intercept it, but not by him that first made it.

Echoes may be produced with different Circumstances:

First, A Plane Obstacle reflects the Sound back in its due Tone and Loudness, Allowance being made for the proportionable Decrease of the Sound according to its Distance.

Secondly, A Convex Obstacle reflects the Sound somewhat smaller, and somewhat quicker, though weaker than it otherwise would be.

Thirdly, A Concave Obstacle echoes back the Sound bigger, slower, and also inverted, but never according to the Order of Words.

Nor does it seem possible to contrive any single *Echo* that shall invert the Sound, and repeat backwards; because in such case, the Word which was last spoken, that

that is, which last occurs to the Obstacle, must be repelled first, which cannot be: For, where, in the mean Time, should the first Words hang and be concealed? or, how after such a Pause, be revived and animated again into Motion?

From the determinate Concavity or Archedness of the reflecting Bodies, it may happen that some of them shall only echo back one determinate Note, and only from one Place

Fourthly, The echoing Body being removed further off, it reflects more of the Sound than when nearer; which is the Reason why some *Echoes* repeat but one Syllable, some one Word, and some many.

Fifthly, Echoing Bodies may be so contriv'd and placed, as that reflecting the Sound from one to the other, either directly and mutually, or obliquely and by Succession, out of one Sound shall arise a *Multiple Echo*, or many *Echoes* arise.

To this may be added, that a *Multiple Echo* may be made by so placing the echoing Bodies at unequal Distances, as that they may reflect all one Way. and not one on the other; by which Means a manifold successive Sound will be heard: One Clap of the Hands will be heard like many; one *Hab*, like a Laughter; one Word, like many of the same Tone and Accent; and so one Vial like many of the same Kind, imitating each other.

Lastly, Echoing Bodies may be so order'd, that from any one Sound given, they shall produce

many *Echoes*, different both as to Tone and Intention.

By which Means a Musical Room may be so contriv'd, that not only Playing on an Instrument in it, shall seem many of the same Sort and Size, but even a Consort of different ones, only placing certain echoing Bodies so, as that any Note play'd shall be return'd by them, in Thirds, Fifths, and Eighths.

Echoes are distinguish'd into divers Kinds, *viz.*

I. *Single Echoes*, which return the Voice but once; of which, some are Tonical, which only return a Voice when modulated in some particular Tone.

Others Polysyllabical, which may return many Syllables, Words, and Sentences.

II. *Multiple* or *Tautological Echoes*, which may return Syllables the same oftentimes repeated.

In *Echoes*, the Place where the Speaker stands, is called the *Centrum Phonicum*, and the Object or Place which returns the Voice, *Centrum Phonicampiticum*.

At the Sepulchre of *Metella*, Wife of *Crassus*, was an *Echo* which repeated what a Man said five Times. And Authors mention a Tower at *Cyzicus*, where the *Echo* was repeated seven Times.

EFFECTION, in Geometry, is used in the same Sense with the Geometrical Construction of Propositions, and often of Problems and Practices; which, when they are reducible from, or founded upon some general Proposition, are called the *Geometrical*

metrical Effections thereunto belonging.

EFFICIENTS, in Arithmetical Progression, are the Numbers given for an Operation of Multiplication called Factors. These *Efficients* are the Multiplicand, and the Multiplier.

EFFIGIES, Σ a Portrait Figure, or Representation of a Person to the Life.

EGGS, in Architecture, an Ornament in that Form, cut in the Echinus or Quarter-Round of the *Ionic* and *Composite* Capitals. The Profile or Contour of an Echinus is enrich'd with *Eggs* and Anchors placed alternately.

ELABORATORY. See LABORATORY.

ELASTICITY is that Property of Bodies whereby they return to their former Figure, when it has been altered by any Force: For if a compact Body be dented in, without the Parts falling into that Dent, the Body will return to its former Figure, from the mutual Attraction of its Parts.

All Bodies, in which we observe *Elasticity*, consist of small Threads or Filaments, or at least may be conceived as consisting of such Threads; and it may be suppos'd that those Threads laid together make up one Body: Therefore that we may examine *Elasticity* in the Case which is the least complex, we must consider Strings of Musical Instruments, and such as are of Metal; for Cat-Gut Strings have a spiral Twist, and cannot be consider'd in the same Manner as those

Fibres with which Bodies were form'd.

The *Elasticity* of *Fibres* consists in this, that they can be extended, and taking away the Force by which they are lengthened, they will return to the Length they had at first.

Fibres have no *Elasticity*, unless they are extended with a certain Force; as it appears in Strings which have their Ends fix'd without being stretch'd; for if you remove them a little from their Position, they do not return to it; but what the Degree of Tension is, which gives beginning to their *Elasticity*, is not yet determin'd by Experiments.

When a Fibre is extended with too much Force, and this Degree of Tension is also unknown: This we do know, that the Degree of Tension in Fibres, which constitutes *Elasticity*, is confin'd to certain Limits.

Hence appears the Difference of Bodies that are *Elastick*, and such as are not so; why a Body loses its *Elasticity*, and how a Body destitute of *Elasticity*, acquires that Property. A Plate of Metal, by repeated Blows of an Hammer, becomes *Elastick*, and by being heated, does again lose that Virtue.

Between the Limits of Tension that terminate *Elasticity*, there is a different Force requir'd for different Degrees of Tension in, or to stretch Cords to certain Lengths. What this Proportion is, must be determin'd by Experiments; which must be made with Chords of Metal.

ELBOW, in Architecture, a Term used for an Obtuse Angle of

of a Wall, Building, Road, &c. which divides it from its Right Line.

ELEMENTS, by Geometricians, Natural Philosophers, &c. are usually taken to signify the same as Principles or Rudiments of any Science. So when Natural Philosophers say, *the Elementary Principles of mixed Bodies*, they mean the simple Particles out of which the mixed Body is compos'd, and into which it is ultimately resolvable.

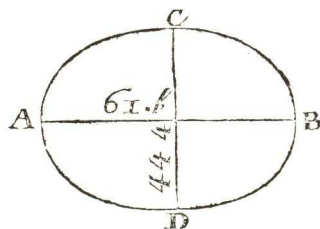
ELLIPSIS, in Geometry, is one of the Conick Sections, properly call'd an Oval or Oblong.

Ellipsis, or *Oval*, is a Figure bounded by a regular Curve Line, returning into itself; but of its two Diameters cutting

each other in the Centre, one is longer than the other, in which it differs from the Circle.

To find the Area thereof, this is the RULE.

Multiply the Transverse Diameter by the Conjugate, and multiply that Product by .7854, and this last Product will be the Area of the *Ellipsis*.



61.6. the Transverse Diameter.

$$\begin{array}{r}
 61.6 \\
 44.4 \\
 \hline
 2464 \\
 2464 \\
 2464 \\
 \hline
 273504 \\
 .7854 \\
 \hline
 1094016 \\
 1267520 \\
 2188032 \\
 1914528 \\
 \hline
 2148.100416 \text{ the Area of the Oval.}
 \end{array}$$

DEMONSTRATION.

If you circumscribe any *Ellipsis* with a Circle, and suppose an infinite Number of Chord Lines drawn therein, all parallel

to the Conjugate Diameter, as those in the Figure above, then it will be,

As DA the Diameter of the Circle is to Nn the Conjugate Diameter of the *Ellipsis*; so is B a B any Chord in the Circle to *bab*

bab , its respective Ordinate in the *Ellipsis*.

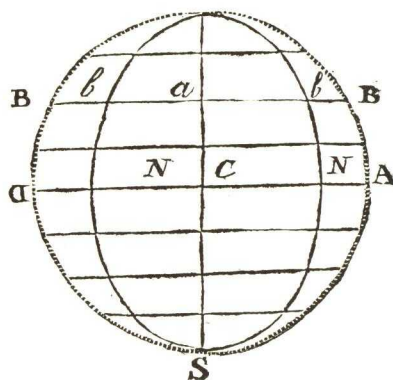
For, according to the Property of the Circle,

It is $1 \mid aS \times Tc = \square Ba$, by the Property of the *Ellipsis*.
 and $2 \mid \square TC : NC :: S \times Ta : \square ba$
 it is $3 \mid \square TC : NC :: \square Ba : \square ba$
 $1.2 \mid 4 \mid TC : NC :: Ba : ba.$

3 Hence $\left| \begin{array}{l} 5 \\ 6 \end{array} \right| \begin{array}{l} 2 TC : 2 NC :: Ba : ba \\ DA : Nn :: BaB : bab. \end{array}$
 Consequ. That is

But the Sum of an infinite Series of such Chords as Bab do constitute the Area of the Circle; and the Sum of the like Series of

their respective Ordinates, as bab , do constitute the Area of the *Ellipsis*.



Therefore $TS : Nn ::$ Circle's Area : the *Ellipsis* Area but $TS : Nn :: \square TS : TS \times Nn$; whence it follows that

$\square TS : \text{Circle's Area} :: TS \times Nn : \text{Ellipsis Area}.$

Consequently, as 1 is to .7854, so is the Rectangle or Product of the Transverse and Conjugate Diameter of any *Ellipsis* to its Area.

Hence it is easy to conceive that the square Root of the Product of the Transverse and Conjugate Diameters will be the Dia-

meter of a Circle equal to the *Ellipsis*.

ELLIPTICK, } of or per-
 ELLIPTICAL, } taining to
 an *Ellipsis*. *Serlio, Hartman,*
&c. demonstrate, that the best
 Form for Arches or Vaults, is
Elliptical.

Elliptick Space is the Area contain'd within the Circumference or Curve of the *Ellipsis*.

Elliptical Compasses, an Instrument usually made of Brass for drawing an *Ellipsis* or Oval at one Revolution of an Index.

ELM

ELM is of singular Uses, where it may lie continually wet or dry in Extreame, therefore proper for Water-Works. Mills, Ladders, and Soles of Wheel-Pipes, Aqueducts, Pales, Ship-Planks, beneath the Water-Line. Some of it found in Bogs has turn'd like the most polish'd and hardest Ebony.

It is also of Use for Wheel-wrights, Handles for single Saws, the knotty Parts for Naves, and Hubbs; the straight and smooth for Axletrees; and the very Roots for curiously dappled Works, Kerbs of Cop-pers, Featheredge, and Weather-Boards, Trunks, Coffins, and Shovel-Board Tables. The Tenor of the Grain makes it also fit for all Kinds of Carved Work, and most Ornaments be-longing to Architecture.

Vitruvius commends it for Tenons and Mortises.

EMBOSSING, ζ in Architec-IMBOSSING, ζ ture, Sculpture, &c. is the forming, or fashioning of Works in Relievo, whether cut with a Chissel, or otherwise; it is a kind of Sculpture or Engraving, wherein the Figures stick out from the Plane whereon it is engraven, and according as they are more or less protuberant.

It is called by the *Italians*, Basso, Mezzo, or Alto Relievo, and by the *English*, Bass-Relief, Mean Relief, or High Relief.

EMBRASURE, in Archi-tecture, is the Enlargement made of a Gap or Aperture of a Door or Window on the Inside of a Wall.

Its Use is to give the greater Play for the opening of the

Door, Wicket, Casement, &c. or to take in the more Light.

The *Embrasure* coming slo-ping inwards, renders the inner Angles obtuse. When the Wall is very thick, they sometimes make *Embrasures* on the Out-side.

EMPASTING, in Painting, is the laying on Colours thick and bold; or the applying fe-veral Lays of Colours, to the End that they may appear thick.

ENDECAGON, ζ in Geo-
HENDECAGON, ζ metry, a Figure having eleven Angles, and consequently as many Sides.

ENGINE, in general, is any Mechanick Instrument compos'd of Wheels, Screws, Pullies, &c. by the Help of which, a Body is either mov'd or hindred from moving.

First, When the Quantities of Motion, in the Weight and Power, are equal, the *Engine* shall stand in *equilibrio*; but when they are unequal, the greater Quantity of Motion shall overcome and work the *En-gine*.

Secondly, Of Forces in them-selves equal, that which is near-est to that Point of the *En-gine*, about which the Weight and Power move, or upon which they sustain each other, is relatively the weakest upon the *Engine*; for as the *Engine* works, the nearest Force moves the slowest, and therefore has the least Quantity of Motion.

Thirdly, The Effect of any Force upon the *Engine*, will not be changed, if, without changing the Line of Direction, it is only placed in some other Point of the same Line.

The Nature of any *Engine* is explain'd, when it is known in what Circumstances the Weight and Power will be *in æquilibrio* upon that *Engine*.

Fourthly, In all *Engines* whatsoever, the Weight and Power will be *in æquilibrio*, when their Quantities are in the reciprocal Proportion of the Velocities, which the Working of the *Engine* will give them.

If an *Engine* be compounded of several simple *Engines*, the Power is to the Resistance, when it counterbalances it in a Ratio, compounded of all the Ratios which the Powers in each simple *Engine* would have to the Resistance, if they were separately apply'd.

ENNEAGON, a Figure of nine Angles and nine Sides.

ENTABLATURE, γ in Architecture, $\S$ which *Vitruvius* and *Vignola* call Ornament, is that Part of an Order of a Column, which is over the Capital, and comprehends the Architrave, Frize, and Cornice.

The *Entablature* is also called the Trabeation, and seems borrow'd from the *Latin Trabs*, a Beam. But some derive it from *Tabulatum*, *L.* a Ceiling; because the Frize is supposed to be form'd by the Ends of the Joists, which bear upon the Architrave.

It is different in different Orders: Indeed, it does consist of the three grand Parts or Divisions above mentioned in all; but those Parts consist of a great or less Number of particular Members or Subdivisions, ac-

ording as the Order is more or less rich.

Vignola makes the *Entablature* a quarter of the Height of the whole Column in all the Orders:

In the *Tuscan*, and *Doric*, the Architrave, Frize, and Cornice, are all of the same Height.

In the *Ionic*, *Corinthian*, and *Composite*, the whole *Entablature* being fifteen Parts, five of these go to the Architrave, four to the Frize, and six to the Cornice.

Entablature, γ in Masonry, is *Entablement*, $\S$ used for the last Row of Stones on the Top of the Wall of a Building, on which the Timber and the Covering rest.

It is often made to project beyond the Naked of a Wall, to carry off the Rain.

The *Entablement* of the *Tuscan* Order, says *M. Le Clerc*, consists of three principal Parts; a Cornice, a Frize, and an Architrave.

To the first, that is, the Cornice, he gives about two Fifths of the Height of the *Entablement*.

The Frize he makes somewhat higher than the Architrave, to the End that those two Members may appear to have nearly the same Height; the Overplus given to the Frize, being intended to supply the Place of that Part hidden from the Eye by the *Tænia*, which finishes the Architrave. And this same Rule, he says, he uses in all his *Entablements*.

Of the *Entablement* of the Column raised on a Pedestal, he tells

tells us, he always makes two Designs of an *Entablement*; the one a small Matter higher than the other; the first for Columns that have no Pedestals, and the second for those that have. This Difference of *Entablement* is a Thing highly reasonable, in regard Columns that have Pedestals, are in a more stately Ordinance than those which have none, provided the Columns be but equal in other Respects. Whence 'tis apparent, the *Entablement* of the first should be stronger than that of the last: Accordingly, making one *Entablement* three Modules and fifteen Minutes, which is the common Height, he says, he could not think it advisable to make the other, which is for Columns without Pedestals, above three Modules, ten Minutes; which comes five Minutes short of the former.

I am sensible, says he, that were we only to have Regard to the Laws of Strength and Weakness, we should diminish the *Entablements* of Columns that have Pedestals, rather than those which have none.

But we are here, says he, consulting Beauty, not Strength; and it may be observed, I don't augment the Strength of this *Entablement*, but diminish that of the former, where the Porticoes are less grand, and the Columns less distant.

Of *Entablatures* which have Breaks, and project unequally, M. Le Clerc says, the *Entablature* is sometimes made to give back or retreat a little between the Columns; but on extraordinary Occasions, and for special

Reasons, as where there are not large Stones sufficient to carry out the whole *Entablature* to its due Pitch; or where a great Projecture between the Columns might intercept the Light necessary underneath, or prevent the View of any Thing above. But, however, it must not be forgot that the principal End of the *Entablature*, is to shelter what is underneath; which, in this Case, it only does by Halves, as having nothing but the bare Projecture of the Cornice for that Purpose.

ENTERSOLE, in Architecture, a kind of little Story, sometimes called a Mezzanine, contriv'd occasionally at the Top of the first Story, for the Convenience of a Wardrobe, &c.

ENTRY, a Door, Gate, Passage, &c. through which we arrive at any Place.

EPICYCLOID, in Geometry, a Curve, generated by the Revolution of a Point of the Periphery of a Circle along the convex or concave Part of another Circle.

EPISTYLE, in the ancient Architecture, a Term used by the Greeks, for what we call Architrave. viz. a massive Piece of Stone or Wood laid immediately over the Capital of a Column.

EQUAL is a Term of Relation between two or more Things of the same Magnitude, Quantity, or Quality.

Equal Circles are those whose Diameters are equal.

Equal Angles are those whose Sides are inclin'd alike to each other, or that are measured by similar Parts of their Circles.

Equal Figures are those whose Areas are *equal*, whether the Figures be similar or not.

Equal Solids are such as comprehend or contain each as much as the other, or whose Solidities and Capacities are *equal*.

Equal Geometrical Ratio's are those whose least Terms are similar aliquot or aliquant Parts of the greater.

Equal Arithmetical Ratio's are those wherein the Difference of the two less Terms is equal to the Difference of the two greater.

Proportion of EQUALITY, evenly ranged, or *Ex aequo ordinata*, is that wherein two Terms in a Rank or Series are proportional to as many Terms of another Rank. *i. e.* the first of one Rank to the first of another, and the second to the second, &c.

Proportion of Equality evenly disturb'd, called also, *Ex aequo perturbata*, is that wherein more than two Terms of a Rank are proportional to as many Terms of another Rank, compared to each other in a different and interrupted Order.

EQUIANGULAR, in Geometry, is apply'd to Figures whose Angles are all equal, as a Square is an *equiangular* Figure. All equilateral Triangles are also *equiangular*.

When the three Angles of one Triangle are severally equal to the three Angles of another Triangle, the Triangles are also said to be *equiangular*.

EQUICRURAL TRIANGLE, *i. e.* having equal Legs, is what we more usually call an *Isoceles*.

EQUIDIFFERENT, in Arithmetick. If in a Series of three Quantities, there be the same Difference between the first and second, as there is between the second and third, they are said to be *continually equidifferent*.

But if in a Series of four Quantities, there be the same Difference between the first and second, as there is between the third and fourth, they are said to be *discreetly indifferent*. Thus 3, 6, 7, and 10, are *discreetly equidifferent*, and 3, 6, and 9, *continually equidifferent*.

EQUIDISTANT, in Geometry, is a Term of Relation between two Things which are every where at one Equal, or the same Distance from each other: Thus parallel Lines are said to be *equidistant*, as they neither approach nor recede: And Parallel Walls are *equidistant* from each other.

EQUILATERAL is a Term apply'd to any Thing, the Sides of which are all equal. Thus an *Equilateral Triangle* is one whose Sides are all of an equal Length.

In an *Equilateral Triangle*, all the Angles are likewise equal.

All Regular Polygons, and Regular Bodies, are *equilateral*.

EQUILIBRIUM, in Mechanicks, a Term that implies an exact Equality of Weight between two Bodies.

EQUIMULTIPLE, in Arithmetick, is apply'd to simple Magnitudes when multiply'd equally, *i. e.* by equal Quantities or Multipliers.

In Arithmetick, we generally use the Term *Equimultiples* for

for Numbers which contain equally, or an equal Number of Times, their Submultiples.

Thus 12 and 6 are *Equimultiples*, of their Submultiples 4 and 2; in as much as each of them contains its Submultiple three Times.

EVEN NUMBER is that which can be divided into two equal Parts, as 4, 6, 8, &c.

EVENLY-EVEN Number, is that which an even Number measures by an even one; as 16 is an *Evenly-even Number*, because 8 an even Number measures it by 2, an even Number.

Evenly-odd Number is that which an even Number measures by an odd one, as 20, which the even Number 4 measures by the odd one 5.

EVOLVENT, in Geometry, a Term used by some Writers for the Curve which results from the Evolution of a Curve, in Contradistinction to the *Evolute*, which is the first Curve supposed to be opened or evolved.

EVOLUTE, in the Higher Geometry, a Curve supposed to be *evolvd* or *open'd*, and which in opening describes other Curves.

EVOLUTION, in Geometry, is the Unfolding or Opening of a Curve, and making it describe a *Volute*.

Evolution is also used for the Extraction of Roots out of Powers; in which Sense it is directly contrary to *Involution*.

EURITHMY, in Architecture, Sculpture, and Painting, is a certain Majesty, Elegance, and easiness, appearing in the Com-

position of divers Members or Parts of a Body, Painting, or Sculpture, and resulting from the fine Proportion of it.

Vitruvius ranks the *Eurithmia* among the essential Parts of Architecture. He describes it as consisting in the Beauty of the Construction or Assemblage of the several Parts of the Work, which render its Aspect, or its whole Appearance grateful; e.g. when the Height corresponds to the Breadth, and the Breadth to the Length, &c.

From these three Ideas, or Designs, viz. Orthography, Scenography, and Profile, it is, that the same *Eurithmia*, majestic and beautiful Appearance of an Edifice, does result; which creates that agreeable Harmony between the several Dimensions, i. e. between the Length, Breadth, and Height of each Room in a Fabrick, so that nothing seems disproportional, too long for this, or too broad for that, but corresponds in a just and regular Symmetry and Consent of all the Parts with the Whole. *Evelyn's Account of Architects.*

EUSTYLE, in Architecture, a sort of Building in which the Pillars are placed at the most convenient Distance one from another; the Intercolumniations being all just two Diameters, and a quarter of the Column; except those in the Middle of the Face, before and behind, which are three Diameters distant.

EXAGGERATION, in Painting, is a Method of representing Things wherein they are charged too much, or mark'd too

strong either in respect to the Design or the Colouring.

EXAGON. See HEXAGON.

EXPERIMENTUM *Crucis* is a capital leading or decisive Experiment, thus called, as either like a Cross, or Post of Direction placed in the Meeting of several Roads: It guides and directs Men to the true Knowledge of the Nature of the Thing, as it were, extorted by Violence.

EXPONENT, in Arithmetick, or, *Exponent of a Power*, the Number which expresses the Degree of the Power; or which shews how often a given Power is to be divided by its Root, before it be brought down to Unity.

EYE, in Architecture, is used to signify any round Window made in a Pediment, an Attick, the Reins of a Vault, or the like.

Eye of a Dome is an Aperture at the Top of the Dome; as that of the *Pantheon* at *Rome*, or of *St. Paul's* at *London*. It is usually cover'd with a Lanthorn.

Eye of the Volute, in Architecture, is the Centre of the Volutes, or that Point in which the Helix or Spiral, of which it is form'd, commences: Or it is the little Circle in the Middle of the Volutes, in which are found the thirteen Centres for the describing the Circumvolutions of it.

Eye-Brow, in Architecture, is used in the same Sense as Lint or Fillet.

FABRICK, the Structure or Construction of any Thing, particularly a Building, as an House, Hall, Church, &c.

FACADE, } in Architecture,
FACE, } the Front of a Building, or the Side on which the chief Entrance is. Also it is sometimes used for the Side that it presents to a Street, Garden, Court, &c. And sometimes for any Side opposite to the Eye.

FACE, } in Architecture, is

FACIA, } a flat Member, having a considerable Breadth, and but a small Projection; as the Bands of an Architrave, Larmier, &c.

Face of a Stone, in Masonry, is the Superficies or Plane of the Stone that is to lie in the Front of the Work; which is very easily known, when the *Face* is scaped, the *Face* being always opposite to the Back; and the Back going rough as it comes from the Quarry.

But in rough Stones, Workmen generally chuse to make one of those Sides the *Face*, which, when in the Quarry, lay perpendicular to the Horizon, and consequently the breaking, and not the cleaving Way of the Stone.

For a better understanding of which, see STONE.

FACEING of *Timber Building with Brick*. The Manner of this is as follows: All betwixt the Timber and the Wall is a Brick's Length thick, (or a nine Inch Wall,) and against the Timber but half a Brick, or a four and a half Inch Wall.

But this Way of *facing* Timber Buildings is not approved of, by reason that the Mortar does fo extremely burn the Timber.

FACIA } in Architecture,
FASCIA } according to M.
FACIO } *Perrault*, signi-
FACE } fies any flat Mem-
 ber, as the Band of an Archi-
 trave, &c. Some write it *Fa-*
see, as though from the *Latin*,
Fascia, a Swathe, or large Turban,
 which *Vitruvius* uses on the like
 Occasion. In effect it is no
 more than a broad List, or Fil-
 let.

They are commonly made in Architraves, and in the Cornices of Pedestals.

Fascia's, in Brick Buildings, are certain Juttings-out of the Bricks over the Windows of each Story, except the upper one. And these are sometimes plain, like those of Columns; but sometimes they are moulded, which make a very handsome Appearance: And this Moulding is usually a Scima Reverfa at the Bottom, above which are two plain Courses of Bricks, then an Astragal, and lastly a Boulton.

It is the same in Stone Buildings as it is in Brick, and they are also sometimes plain, and sometimes moulded with a Scima Reverfa, or Ogee.

The Price of *Fascia's* is, if the Workman finds materials, usual-

ly about 10*d.* per Foot running Measure; but Workmanship only, is about 6*d.* or 8*d.* per Foot.

Vitruvius means by the Term *Fascia*, (as also *Tenia* and *Corfa*,) what we call *Plat-Band*.

FACTORS, in Arithmetick, is a Name given to the Multiplicand and Multiplicator, because they do *facere productum*, i.e. make or constitute the Product.

FACTUM, in Arithmetick, the Product of two Quantities multiplied by each other.

FEATHER-EDG'D Boards or *Planks*, are such as are thicker on one Side than the other.

PELLING of *Timber*. See **TIMBER**.

FENCING with Pales: As Paling with three Rails, cleft Pales, Rails, and Posts, cleaving and setting up, is usually done at 3*s.* 6*d.* the Rod, reckoning the felling of the Timber into the Bargain; but then their Materials are laid down to their Hands.

Fencing with single Rails and Posts, together with felling, cleaving, and setting up, is usually done at 8*d.* or 10*d.* the Rod; but then also their Materials must be laid down to their Hands, that they may have no carrying.

Some say, that they have known it done for 4*d.* 5*d.* or 6*d.* per Rod, felling, cleaving, and setting up; but then it is when the *Fence* is cross a Field, or the like, where the Post Holes may be easily dug, (and when pretty many Rods are to be done together, and the Materials are also laid down to their Hands.)

and not in Gaps in Hedges, and the like, where the Digging is hard Work, and but a little at a Place; for in such Work it is worth 8*d.* 10*d.* or 1*s.* the Rod.

FENCE WALLS, are Walls of Brick or Stone, made about Gardens, &c.

FESTOON, an Ornament or Garland of Flowers, Fruits, and Leaves, intermix'd or twisted to-



gether: They were antiently much used at the Gates of Temples, where Feasts or solemn Rejoycings were held; or at any other Places where marks of publick Joy and Gaiety were desired; as on Triumphal Arches, Tournaments, &c.

FESTOONS, in Architecture, &c. a Decoration used by Architects, Painters, Joiners, &c. to enrich their Works. It consists of a String or Column of Flowers, Fruits, and Leaves tyed together, somewhat biggest in the Middle, and extended by the two Extremes; besides which, the main Part which falls down in an Arch, two lesser Parts hang perpendicularly: See the Figure.

Festoons are now chiefly used in Friezes, and other vacant Places, which require to be fill'd up and adorn'd.

This Ornament is made in Imitation of the *Festoons*, or long Clusters of Flowers, which the

Antients placed on the Doors of their Temples, &c. on festival Occasions.

FIGURE is the Surface or terminating Extremes of a Body.

Figure also signifies all Representations or Images of Things in Sculpture, Prints, &c.

Figure, in Geometry, signifies a Surface inclos'd, or circumscribed with one or more Lines; as Circles, Ellipses, Triangles, Squares, Polygons, &c.

Figures are either rectilineal or curvilineal, or mix'd, according as the Perimeter consists of Right Lines, Curve Lines, or both.

Rectilineal Figures are those which have their Extremities all Right Lines, as Triangles, Quadrilaterals, &c. Polygons Regular, Irregular, &c.

Curvilineal Figures are such as have their Extremities crook'd; as Circles Ellipses, &c.

Mix'd Figures are such as are bounded partly by Right Lines, and partly by crooked ones; as a Semi-Circle, Segment of a Circle, &c.

Plane Figures, or Plane Surfaces, are such as are terminated and bounded by Right Lines only.

A *Regular Figure*, is that which is equilateral and equiangular.

An *Irregular Figure*, is that which is not both.

Figure, in Conic Sections, according to *Apollonius*, is the Rectangle under the *Latus Rectum* & *Transversum* in the Hyberbola and Ellipsis.

Figure of the Diameter, the Rectangle under any Diameter, and

and its proper Parameter is in the Ellipsis and Hyperbola, called the *Figure of that Diameter*.

Figure, in Painting and Designing, is the Lines and Colours that Form the Representation of a Man, or other Animal.

Figure, in Architecture, &c. signifies the Representations of Things made in solid Matter, as Statues, &c.

Figures, in Arithmetick, are the nine Digits, or numerical Characters, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0; or those by which Numbers are expressed or written.

FILLET } in Architecture, a

FILET } little square Member, or Ornament, or Moulding, used in divers Places, and upon divers Occasions; but generally as a Corona or Crowning over a greater Moulding.

The *Fillet* is the same that is by the *Italians* called *Listra*, or *Listella*; by the *French*, *Reglet*; and by others *Band*, and *Bandelette*.

Fillet, in Painting, Gilding, &c. is a little Rule, or Reglet of Leaf Gold drawn over some Mouldings; or on the Edges of Frames, Pannels, &c. especially when painted white by Way of Enrichment.

FINISHING, with Architects, &c. is frequently used of a Crowning, Acroter, &c. raised over a Piece of Building, to terminate and *finish*, or compleat it.

FIRE-STONE, a sort of Stone called also *Rygate-Stone*, of the Name of the Place from whence it is chiefly brought, being very good for Fire-Hearths, Ovens, Stoves, &c.

As to the Price of *Fire-Stone*, Hearths of it are usually sold at 1 s. per Foot, and Chimney-Corner Stones at 20 s. per Pair; and Blocks for setting up Coppers, each being about three Feet long, one and a half broad, and eight or nine Inches thick, at 6 s. 8 d. per Piece.

FLEMISH BRICKS, a neat strong Sort of Bricks, of a yellowish Colour, brought from *Flanders*, and much used in paving Yards, Stables, &c. being much neater and stronger, than common or Clay Bricks.

These Bricks are six Inches and a quarter in Length, two and a half in Breadth, and one and a quarter thick. Now allowing one Fourth of an Inch for the Joint, 72 of them will pave a Yard square; but if they be set edge-ways, then a Yard square will require 100.

These *Bricks* are usually sold for 2 s. per Hundred.

FLIGHT of a Stair-Case. See **STAIR-CASE**.

FLINT WALLS. See **WALLS**.

FLOOR, in Architecture, is the Underside of the Room, or that Part whereon we walk.

Floors are of several Sorts; some of Earth, some of Brick, some of Stone, and some of Wood.

Carpenters, by the Word *Floor*, understand as well the fram'd Work of Timber, as the Boarding over it.

Earthen Floors are commonly made of Loam, and sometimes (for *Floors* to make Malt on) of Lime and Brook Sand, and Gun-

Dust, or Anvil-Dust from the Forge.

FLOORING, a rural Sort of Work, by which, in this Place, are not meant *Floors* laid with Boards or Planks, but such as are used in plain Country Habitations, and the Manner of making them.

Take two Thirds of Lime, and one of Coal Ashes well-sifted, with a small Quantity of loamy Clay; mix the Whole that you intend to use together, and temper it well with Water; making it up into a Heap, let it lie a Week or ten Days, in which Time it will mellow and digest: Then temper it well over again, and be sure that your Quantity of Water does not exceed, but rather that it may obtain a mellow Softness and Toughness from Labour: Then heap it up again for three or four Days, and repeat the Tempering very high, till it becomes smooth and yielding, tough and glewy.

Then the Ground being levelled, lay your *Floor* therewith about two and a half, or three Inches thick, making it smooth with a Trowel: The hotter the Season is, the better; and when it is thoroughly dry'd, it will continue Time out of Mind.

This makes the best *Floors* for Houses, especially for Malt-Houses; but as for those who cannot get these Materials, or go to the Charge of them, they may take of clayey Loam and new soft Horse-Dung one Third, with a small Quantity of Coal Ashes, if they can be had, and temper these after the aforementioned Manner; and lay the

Floor with the Stuff three or four Inches thick, smooth and even, which will cement, become hard, strong, and durable, being done in a hot and dry Season; good for Cottages, Barns, and other small Houses.

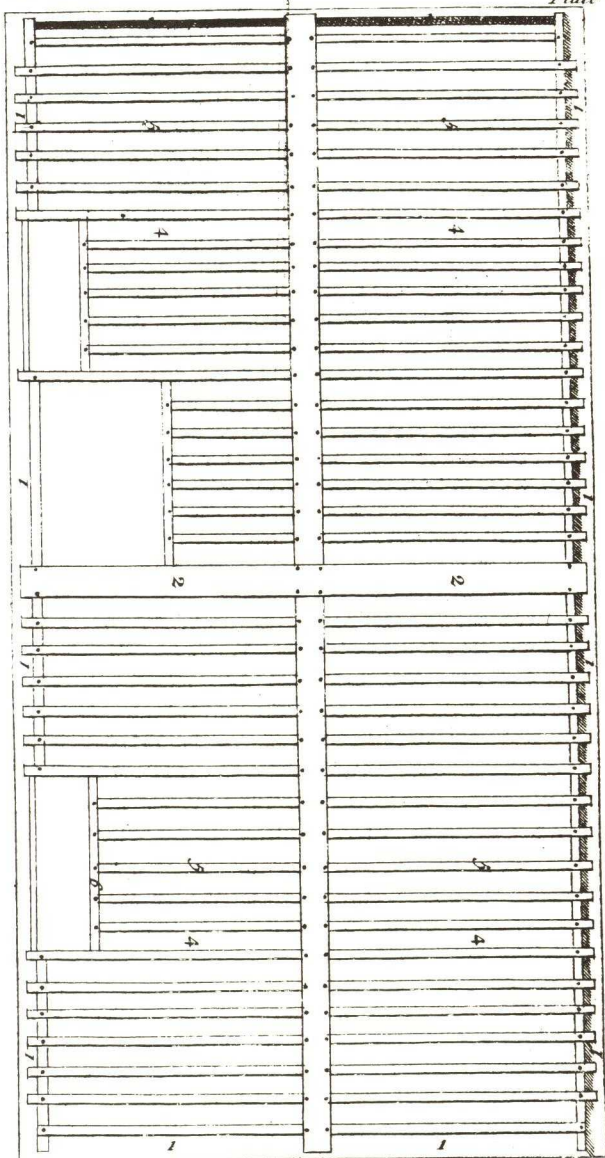
But if any would have more beautiful *Floors* than these, they must lay their *Floors* even, smooth, and fine, either with the first or last mentioned *Flooring*; then take Lime made of Rag-Stones, and temper it with a little Whites of Eggs, the more Eggs the better, to a very high pitch, with which cover your *Floor* about a quarter or half an Inch thick, before the under *Flooring* be too dry, that they may well incorporate together: This being well done, and thoroughly dry, if sometimes rubbed over with Mops or Cloths, with a little Oil thereon, it will look very beautiful and transparent, as if it were polished Metal or Glass, provided the Eggs and Lime were thoroughly tempered, and otherwise well performed.

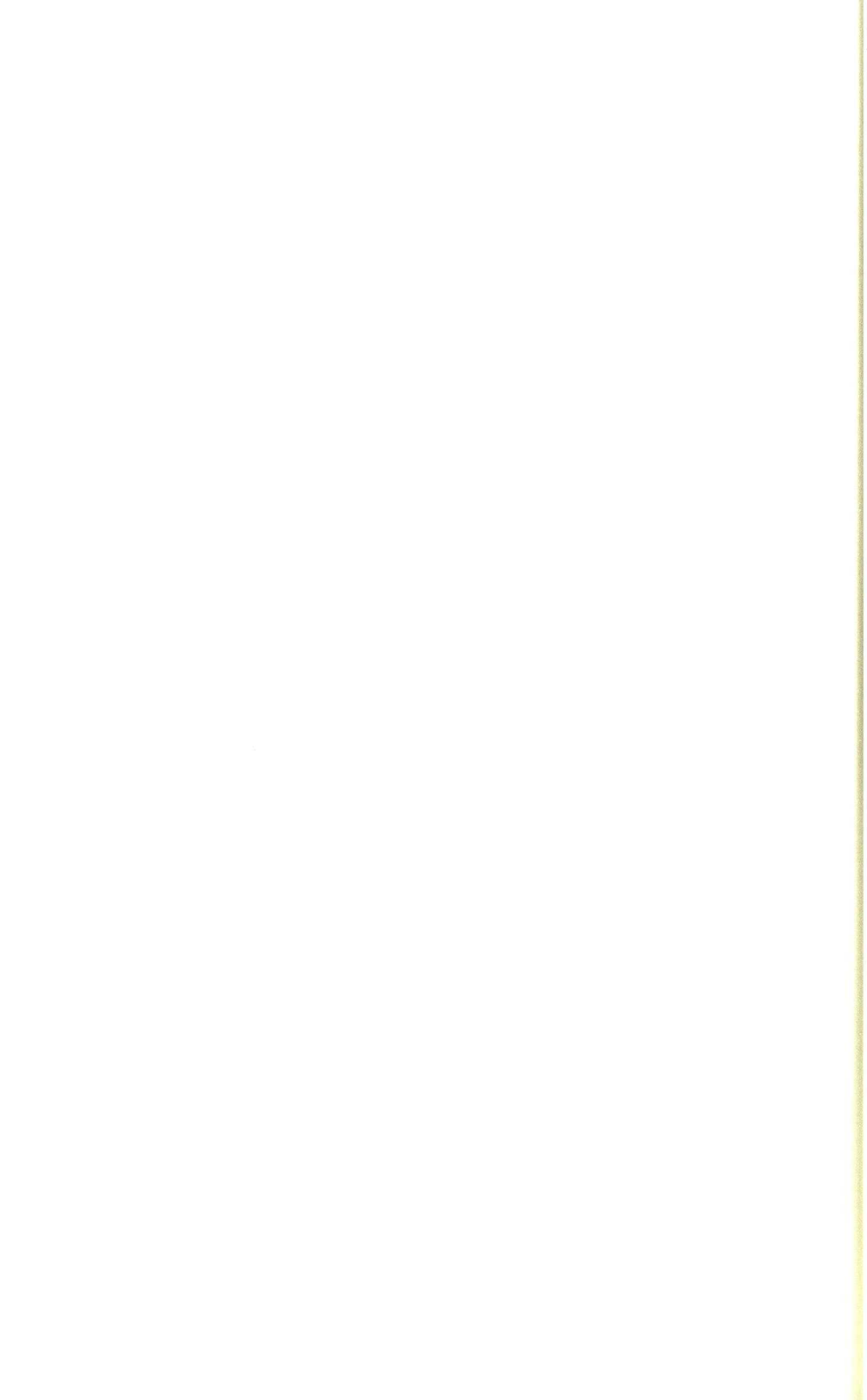
Sir *Hugh Plat* gives us a Receipt for making an artificial Composition wherewith to make smooth, glittering, and hard *Floors*; and which may also serve for plastering of Walls.

Ox Blood and fine Clay tempered together, he says, makes the finest *Floor* in the World; and that this Mixture laid in any *Floor* or Wall, will become a very strong and binding Substance.

For Brick and Stone *Floors*, see **PAVING**.

Concerning Boarded *Floors*, it is to be observed, that the Carpenters





penters never *Floor* their Rooms with Boards, till the Carcase of the House is set up, and also is inclosed with Walls, lest the Weather should wrong the *Flooring*; yet they generally rough-plane the Boards for *Flooring*, before they begin any thing else about the Building, that they may set them by to season, which is done as follows: They lean them one by one on-end asslant, with the Edge of the Board against a Balk somewhat higher than half the Length of the Board, and then they set another Board in the same Posture on the other Side of the Balk, so that the Boards cross one another above the Balk; then on the first Side they set another Board in the same Posture, and on the second Side another, and so proceeding alternately, till the whole Number of Boards is thus set on-end.

The Boards being set up in this Posture, there is left a Space of the Thickness of a Board all the Length of the Boards, but just where they cross one another, for the Air to pass through to dry and shrink them; but they are set under some covered Shed, that neither the Rain nor Sun may come at them: For if they should be wetted with Rain, that would swell them instead of shrinking them; and if the Sun should shine very hot upon them, it would dry them so fast, that they will split or crack, which is what they call *tearing*, or *flaking*.

There is also another Way of drying and seasoning Boards for *Floors*, viz. by laying them flat

upon three or four Balks, each Board about the Breadth of a Board asunder the whole Length of the Balks; then they lay another Lay of Boards athwart the last, and so till they have laid them all after this Manner; so that in this Position they also lie hollow, for the Air to play between them.

Of measuring *Floors*: Boarded *Floors* are usually measured by the Square, (of 100 superficial Feet,) by multiplying the Length of the Room in Feet by the Breadth in Feet, and the Product is the Content in Feet; then the Chimney-Ways and Well-Holes for Stairs are measured by themselves, and their Content in Feet is deducted from the whole Content; and afterwards cut off two Figures from the Remainder on the right Hand, and what remains on the left Hand is Squares, and what are cut off are odd Feet of the Content of the *Flooring* in that Room.

The Price: Mr. *Wing* says, the Framing of *Floors* in ordinary Buildings is worth seven or eight Shillings *per Square*, and in great Buildings ten or eleven Shillings.

Some *Suffex* Workmen say, that they usually have but four Shillings *per Square* for framing *Floors* in ordinary Buildings; and that if they frame the Joists the whole Depth of the Girder, and pay for sawing the Timber, they have nine or ten Shillings *per Square*.

Mr. *Leybourn* says the Price of laying (*i.e.* boarding) of *Floors*, is various, according to the Goodness of the Stuff, from twelve to twenty Shillings *per Square*; but

but if the Builder himself finds the Boards, the common Allowance for planing, jointing, and laying of Boards, is four or five Shillings *per* Square, besides Nails; of which 200 is a competent Allowance for one Square of *Flooring*.

Some *Suffex* Workmen say, they will lay Deal Boards braded, and plain Joints broken at every four or five Boards, for three Shillings *per* Square; and if they break Joint at every Board, then six Shillings, and others say six Shillings and eight Pence, or seven Shillings *per* Square.

Mr. *Wing* likewise says, Plaster *Floors* running, the Workman finding all, are worth one Shilling and four Pence *per* Yard; but the working Part only is worth four Pence, five Pence, or six Pence *per* Yard.

The Manner of Framing a Floor, with the Names of each Member.

1. The Thickness of the Wall and Lintel, or Wall-Plate, and if it be in Timber Work, then a Bress-Summer.

2. The Summer.

3. The Girders fram'd into the Summer.

4. Spaces between the Joists.

5. Joists.

6. Trimmers for the Chimney-Way.

7. Trimmers for the Stair-Cafe, or Well-Hole for the Stairs.

See the Plate.

FLUIDITY is the State or Affection of Bodies, which denotes or renders them fluid, and is directly opposite to Firmness, or Solidity.

It is distinguished from Liquidity and Humidity, in that the Idea of the first is absolute, and the Property contained in the Thing itself; whereas that of the latter is relative, and implies wetting or adhering; *i.e.* somewhat that gives it the Sensation of Wetness or Moisture, and which would have no Existence, but for our Senses.

Thus melted Metals, Air, and even Smoak, and Flame itself, are fluid Bodies, but not liquid ones, their Parts being actually dry, and not leaving any Sense of Moisture.

FLUIDS are Bodies whose Parts are but weakly connected, their mutual Cohesion being in great measure prevented from some external Cause; in which Sense a *Fluid* is opposite to a Solid.

Sir *Isaac Newton* defines a *fluid* Body to be that whose Parts yield to the smallest Force impress'd, and by yielding are easily moved among each other.

Fluids are either natural, as Water, Mercury, &c. or animal, as Blood, Milk, Urine, &c. or fictitious, as Wines, Drinks, Spirits, Oils, &c.

The Knowledge of the Properties of *Fluids* being of use in Hydraulicks, or the conducting of Water, I shall here give some Laws of *Fluids* in that Science.

Hydraulick Laws of Fluids.

1. The Velocity of a *Fluid*, as Water moved by the Pressure of a superincumbent *Fluid*; as Air, is equal at equal Depths.

2. The

2. The Velocity of a *Fluid* arising from the Pressure of a superincumbent *Fluid* at any Depth, is the same as that which a Body would acquire in falling from a Height equal to the Depth.

3. If two Tubes, of equal Diameters, full of any *Fluid*, be of the same Altitude, they will discharge equal Quantities of the *Fluid* in equal Times.

4. If two Tubes of equal Altitudes, but unequal Apertures, or Diameters, be kept constantly full of Water, the Quantities of Water they yield in the same Time, will be as the Diameters; and this whether they be erect, or any way inclin'd.

5. If the Apertures of two Tubes be equal, the Quantities of Water discharged at the same Time, are as their Velocities.

6. If two Tubes have equal Apertures, and unequal Altitudes, the Quantity of Water discharged from the greater, will be to that discharged from the other in the same Time, in a subduplicate Ratio of the Altitudes.

7. If the Altitude of two Tubes be unequal, and the Apertures likewise unequal, the Quantities of Water discharged in the same Time, will be in a Ratio compounded of the simple Ratio of the Apertures, and the Subduplicate of one of the Altitudes.

8. If the Altitudes of two Tubes be equal, the Water will flow out with equal Velocity, however unequal the Apertures be.

9. If the Altitude of two Tubes, as also their Apertures, be unequal, the Velocities of the Water discharged are in a subduplicate Ratio of their Altitudes.

10. The Altitudes and Apertures of two Cylinders full of Water being the same, one of them will discharge double the Quantity of Water discharged in the same Time by the other, if the first be kept continually full, while the other runs itself empty.

11. If two Tubes have the same Altitudes, and equal Apertures, the Times wherein they will empty themselves, will be in the Ratio of their Bases.

12. Cylindrick and Prismatick Vessels empty themselves by this Law, That the Quantities of Water discharged in equal Times, decrease according to the uneven Numbers 1, 3, 5, 7, 9, &c. taken backwards.

13. If Water descending through a Tube Spout up at the Aperture, whose Direction is vertical, it will rise to the same Altitude at which the Level of the Water in the Vessel does stand.

14. The Length or Distances to which Water will Spout, either through an inclin'd or an horizontal Aperture, are in a subduplicate Ratio of the Altitudes in the Vessel or Tube. See HYDRAULICKS and WATER.

FLUTES } in Architec-
FLUTINGS } ture, are per-
pendicular Channels or Cavities cut along the Shaft of a Column or Pilaster.

They

They are supposed, as *Vitruvius* says, to have been first introduced in Imitation of the Plaits of Women's Robes or Garments.

The *French* call them *Channellures*, i. e. Channellings, as being Excavations; and we call them *Flutes*, or *Flutings*, as bearing some Resemblance to the musical Instrument called a *Flute*.

They are chiefly affected in the *Ionic* Order, where they had their first Rise; though indeed they are used in all the richer Orders, as the *Corinthian* and *Composite*, but seldom in the *Doric*, and scarce ever in the *Tuscan*.

Each Column has 24 *Flutes*, and each *Flute* is hollow'd in exactly a Quadrant of a Circle; but the *Doric* has but 20.

Between the *Flutes* are little Spaces that separate them, which *Vitruvius* calls *Striae*, and we *Lists*; though in the *Doric* the *Flutes* are frequently made to join to one another, without any intermediate Space at all, the List being sharpened off to a thin Edge, which forms a Part of each *Flute*.

Vignola determines the Depth of the *Flutes* by taking the Angle of the equilateral Triangle for the Centre.

Vitruvius describes the Depth from the Middle of the Square, whose Side is the Breadth of the *Flute*: Which latter Method makes them deep.

Some Columns have *Flutes* that go winding round the Shaft spirally; but this is rather accounted an Abuse.

The *Flutes* or *Striae* are frequently filled up with a prominent or swelling Ornament; sometimes plain, in Form of a Staff or Reed, and sometimes a little carved or enriched, in Imitation of a Rope, or otherwise; and therefore called *Rudenture*, or *Cabling*, and the Columns that are thus enrich'd, *Cabled Columns*.

This is most often done in the *Corinthian* Order; the *Cablings* or *Fillings* up commence from about one Third of the Height of the Column, reckoning from the Base, and are continued to the Capital, that is, they begin and end with the Diminution of the Column.

Flutings of the *Doric* Column, *M. Le Clerc* says, ought not to exceed 20, which is the Number observed by *Vignola*.

Palladio indeed has 24; but they appear too slender for this Order.

These should always be so disposed, as that there may be one to stand full in the Middle of the Column.

Vignola determines their Depth by an equilateral Triangle, having one of its Angles in the Middle of the *Fluting*.

Vitruvius will have the Depth to be the Middle of a Square, one of whose Sides is the Width of the *Fluting*; which last must indeed be the deeper of the two.

Sometimes the *Flutings* are made flat, and are called *Facettes*; but these never have so good an Effect as the others, and for that Reason are not so much in use; though it can't be deny'd, but
that

that they are more suitable to the Solidity of the Order.

He likewise adds, that the *Flutings* ought always to begin and end in the Shaft, near the Extremity of the Apophyges.

When there are *Flutings* in the Column, there ought also to be Eggs and Anchors in the Quarter-Round of the Capital, and even Pearls and Olives in a Baguette, to be made underneath in lieu of Anulets.

These Eggs and Olives ought to be in the same Number with the *Flutings*, and to be regularly distributed.

The *Flutings* of the *Roman* Order he makes also 24, as in the *Ionic*; but to distinguish them, he makes those of the *Composite* flat at Bottom, and only a Minute and a quarter deep, but twice as much in Width.

As to the *Flutings* of the *Corinthian* Order, he says, if we were only to have regard to this Order, the *Flutings* of the *Ionic* would suit it very well; but when the two Orders may be compared together, as will be the Case if they are placed over one another, then these *Flutings* may easily have the additional Ornaments of a little Fillet running quite round.

When *Flutings*, says he, are used in Pilasters, their Number should be seven on each Side: The first and last of which may be a little further from the Angle than the rest are from each other, that the Extremities of the Pilasters may not be too much weakened.

He adds, in some old Monuments we find Pilasters which

have only five *Flutings* on a Side; but then these are too large, and make the Pilasters appear little and pitiful; and if there were nine, they would be too fine and slender, even for the most delicate Orders.

We never, says he, make *Flutings* in the *Tuscan* Pilaster; and if by chance we make any in the *Doric*, (which however is very rare,) we leave pretty large Spaces next to the Extremities, in order to fortify the Angles.

One may either add a single *Fluting* in the Projecture or Thickness of the Pilaster, or leave it quite plain, provided it don't exceed ten Minutes in Breadth.

FLYERS, in Architecture, are such Stairs as go straight, and do not wind round, nor are its Steps made tapering, but the fore and back Part of each Stair, and the Ends, respectively parallel to one another; or the second of these *Flyers* standing parallel behind the first, and the third behind the second, and so of the rest.

So that if one Flight do not carry to your intended Height, then there is a broad half Space; from thence you begin to fly again, with Steps every where of the same Breadth and Length, as before.

FOCUS, in Geometry and Conic Sections, is a Term applied to certain Points in the Parabola, Ellipsis, and Hyperbola, wherein the Rays reflected from all Parts of those Curves do concur and meet.

FOLIAGE, a Cluster or Assemblage of Flowers, Leaves, Branches, &c.

Foliage

Foliage is particularly used for the Representations of such Flowers, Leaves, Branches, Rinds, &c. whether natural or artificial, used as Enrichments on Capitals, Friezes, Pediments, &c.

FOOT is a Measure consisting of 12 Inches, supposed to be the ordinary Length of the *Foot* of a Man.

The *Foot* long is divided into 12 Inches; and the Inch is supposed to be the Length of three Corns of Barley laid lengthwise.

The *Foot* is divided by Geometricians into 10 Digits, and the Digit into 10 Lines, &c.

The *French* divide their *Foot*, like us, into 12 Inches, and the Inch into 12 Lines, &c.

The *Foot square* is the same Measure both in Length and Breadth, containing 144 square or superficial Inches.

The *Cubic* or *Solid Foot* is the same Measure in all the three Dimensions, containing 1728 Cubic Inches.

The *Foot* is of different Lengths in different Countries.

The *Paris Royal Foot* exceeds the *English* by 7 Lines and a half.

The ancient *Roman Foot* of the Capital consisted of four Palms, equal to four Inches and seven Tenths *English*.

The *Rhinland* or *Leyden Foot*, by which all the Northern Nations reckon, is to the *Roman Foot* as 950 to 1000.

The Proportion of the principal *Feet* of several Nations, compared with the *English* and *French*, are as follows:

The *English Foot* being divided into 1000 Parts, or into 12 Inches, the other *Feet* will be as follows:

	Ft.	Inc.	Lin.
<i>London</i>	Foot 1000	0	12 0
<i>Paris, the Royal</i>	Foot 1068	1	00 8
<i>Amsterdam</i>	Foot 942	0	11 3
<i>Antwerp</i>	Foot 946	0	11 2
<i>Dort</i>	Foot 1184	1	2 2
<i>Rhinland, or Leyden</i>	Foot 1033	1	0 4
<i>Mechlin</i>	Foot 919	0	11 0
<i>Middleburg</i>	Foot 991	0	11 9
<i>Strasburg</i>	Foot 920	0	11 0
<i>Lorraine</i>	Foot 958	0	11 4
<i>Cologne</i>	Foot 954	0	11 4
<i>Bremen</i>	Foot 964	0	11 6
<i>Frankfort on the Mayn</i>	Foot 948	0	11 4
<i>Spanish</i>	Foot 1001	0	11 0
<i>Toledo</i>	Foot 899	0	10 7
<i>Roman</i>	Foot 967	0	11 6
<i>Bolonia</i>	Foot 1204	1	2 4
<i>Mantua</i>	Foot 1569	1	6 8
<i>Venice</i>	Foot 1162	1	1 9
<i>Dantzick</i>	Foot 944	0	11 3

F O

F O

		Ft.	Inc.	Lin.
<i>Copenhagen</i>	Foot	965	0	11 6
<i>Riga</i>	Foot	1831	1	9 9
<i>The Greek</i>	Foot	1007	1	0 1
<i>The Paris (by Dr. Bernard)</i>	Foot	1066	1	0 1
<i>Old Roman</i>	Foot	970	0	11 0

The *Paris Foot* being supposed to contain 1440 Parts, the rest will be as follows :

<i>Paris</i>	Foot	1140
<i>Rhinland</i>	Foot	1391 $\frac{1}{16}$
<i>Roman</i>	Foot	1320
<i>London</i>	Foot	1350
<i>Swedish</i>	Foot	1320
<i>Danish</i>	Foot	1403
<i>Venetian</i>	Foot	1540
<i>Constantinopolitan</i>	Foot	1320
<i>Bononian</i>	Foot	1682 $\frac{1}{2}$
<i>Strasburg</i>	Foot	1282 $\frac{1}{4}$
<i>Norimberg</i>	Foot	1346 $\frac{1}{4}$
<i>Dantzick</i>	Foot	1721 $\frac{1}{2}$
<i>Italy</i>	Foot	1320

FOOT-PACE, } is a Part of
 HALF-PACE, } a Pair of
 Stairs, whereon, after four or
 six Steps, you arrive at a broad
 Place, where you may take two
 or three Paces before you ascend
 another Step, by that Means to
 ease the Legs in ascending the
 rest of the Steps.

FORNICATION is an Arch-
 ing or Vaulting.

FOUNDATION is that Part
 of a Building, which is under
 Ground, or the Mass of Stone,
 Brick, &c. which supports a
 Building, or upon which the Walls
 of a Superstructure are raised
 Or it is the Coffer or Bed dug
 below the Level of the Ground,
 to raise a Building upon; in
 which Sense, the Foundation ei-
 ther goes to the whole Area

or Extent of the Building ; as
 when there are to be Vaults,
 Cellars, or the like ; or it is
 drawn in Cuts or Trenches, as
 when only Walls are to be
 raised.

The *Foundation* is properly
 so much of the Masonry, or
 Bricklayers Work, as reaches as
 high as the Surface of the
 Ground, and ought always to be
 proportion'd to the Load or
 Weight of the Building that it is
 to bear.

Sometimes the *Foundation* is
 massive, and continu'd under the
 whole Building, as in the an-
 tique Arches and Aqueducts, and
 some Amphitheatres : But it is
 more usually in Spaces or Inter-
 vals, either to avoid Expence, or
 because the Vacuities are at too
 great

great a Distance, in which latter Case, they make use of insulated Pillars, bound together by Arches.

Of Digging for, and Laying of Foundations.

There are several Things to be well consider'd in laying the *Foundations* of a Building, the most material of which are here extracted from the best Architects Antient and Modern.

That we may *found* our Habitation firmly, requires the exactest Care: For, says Sir Henry Wooton, if the *Foundation* dance, 'twill marr all the Mirth in the House.

Therefore, says that excellent Architect, we must first examine the Bed of Earth upon which we are to build, and then the under Fillings or Substruction, as the Antients called it.

For the former, we have a general Precept in *Vitruvius*, twice repeated by him as a Point indeed of main Consequence; *Substructionis* *Foundationes* *fodiuntur, si queant inveniri ad solidum & in solido*: By which, he recommends not only a diligent, but even jealous Examination what the Soil will bear; advising us not to rest upon any appearing Solidity, unless the whole Mould through which we cut, have likewise been solid.

But he has no where determin'd how far we should go in this Search, as perhaps depending more upon Discretion than Regularity, according to the Weight of the Work.

But yet *Palladio* has ventured to reduce it to a Rule; and al-

lows a sixth Part of the Height of the whole Building for the *Cavazione*, i. e. hollowing or under-digging, unless there be Cellars under Ground; in which Case, he would have it somewhat lower. See Sir Henry Wooton's *Elements of Architecture*.

Palladio also lays down several Rules to know if the Earth be firm enough for the *Foundation*, (without artificial Helps,) by Observations from the digging of Wells, Cisterns, and the like, (which he would have to be done in the first Place) and from Herbs growing there, if there be such as usually spring up in firm Ground; also if a great Weight be thrown on the Ground, it neither sounds nor shakes; or if a Drum being set on the Ground, or lightly touch'd, it does not resound again, nor shake the Water in a Vessel set near it. These, says he, are Signs of firm Ground. But the best Way to discover the Nature of the Soil, is to try it with an Iron Crow, or else with a Borer, such as is used by Well-Diggers.

Architects ought to use the utmost Diligence in this Point; for, of all the Errors that may happen in building, those are the most pernicious, which are committed in the *Foundation*; because they bring with them the Ruin of the whole Building; nor can they be amended without very great Difficulty.

Foundations are either natural, or artificial: Natural, as when we build on a Rock, or very solid Earth; in which Case, we need not seek for any further

ther Strengthening: For these, without Digging, or other artificial Helps, are of themselves excellent *Foundations*, and most fit to uphold the greatest Buildings.

But if the Ground be sandy or marshy, or have lately been dug, in such Case, Recourse must be had to Art. In the former Case, the Architect must adjust the Depth of the *Foundation* by the Height, Weight, &c. of the Building: A sixth Part of the whole Height is looked upon as a Medium; and as to Thickness, double that of the Width of a Wall is a good Rule.

If you build upon mossy and loose Earth, then you must dig till you find sound Ground.

This sound Ground (fit to uphold a Building) is of divers Kinds; (as *Alberti* well observes,) in some Places 'tis so hard, as hardly to be cut with Iron, in other Places very stiff, in other Places blackish, in others whitish, (which is accounted the the weakest,) in others like Chalk, and in others sandy; but of all these, that is the best that requires most Labour in cutting or digging, and when wet, does not dissolve into Dirt.

If the Earth to be built on is very soft, as in Moorish Grounds, or such that the natural *Foundation* cannot be trusted, then you must get good Pieces of Oak, whose Length must be the Breadth of the Trench, or about two Foot longer than the Breadth of the Wall: These must be laid cross the *Foundation*, about two Feet asunder, and being well ramm'd down, lay long Planks

upon them; which Planks need not lie so broad as the Pieces are long, but only about four Inches of a Side wider than the Basis or Foot of the Wall is to be, and pinn'd or spik'd down to the Pieces of Oak on which they lie.

But if the Ground be so very bad, that this will not do, then you must provide good Piles of Oak of such a Length as will reach the good Ground, and whose Diameter must be about one twelfth Part of their Length. These Piles must be forced or drove down with a Commander, or a Machine or Engine for that Purpose, and must be placed as close as one can stand by another; then lay long Planks upon them, and spike or pin them down fast.

But if the Ground be faulty, but here and there a Place, and the rest of the Ground be good, you may turn Arches over these loose Places, which will discharge them of the Weight.

You must not forget to place the Piles not only under the outer Walls, but also under the inner Walls that divide the Building; for if these should sink, it would be a Means to make the outer Wall crack, and so ruin the whole Building.

Having thus far consider'd the Bed of Earth on which the Building is to be erected, we shall next consider the Substruction, as it was called by the Antients, but the Moderns generally call it the *Foundation*.

This is the Ground-Work of the whole Edifice which must sustain the Walls, and is a kind of Artificial, as the other was Natural: As to which, these

Things that follow, are the most necessary to be observ'd.

First, That the Bottom may be exactly level; therefore lay a Platform of good Board.

Secondly, That the lowest Ledge or Row be all of Stone, (the broader the better,) laid closely without Mortar; which is a general Caution for all Parts of a Building that are contiguous to Board or Timber; because Lime and Wood are utter Enemies to one another; and if unfit Confiners any where, then they are more especially so in the *Foundation*.

Thirdly, That the Breadth of the Substruction be at least double the Breadth of the Wall that is to be rais'd upon it.

But even in this Case, Art ought to give way to Discretion; and the Substruction may be made either broader or narrower, according as the Goodness of the Ground, and the Ponderosity of the Edifice requires.

Fourthly, That the *Foundation* be made to diminish as it rises, but yet so, that there may be as much left on the one Side as the other; so that the Middle of that above may be perpendicularly over the Middle of that below: Which ought in like manner to be observ'd in diminishing the Walls above Ground; for by this Means, the Building will become much stronger than it would be, if the Diminution were made any other Way.

Fifthly, That you ought never to build upon the Ruins of an old *Foundation*, unless you are well assur'd of its Depth, and that its Strength is sufficient to bear the Building.

Lastly, There is a curious Precept in the Writings of some ancient Architects, *That the Stones in the Foundation should be laid as they naturally lay in the Quarry*; they supposing them to have most Strength in their natural Position.

This Precept is generally observ'd by all good modern Artists, not only in the *Foundation*, but also in all the Parts of the Superstructure; and that for a better Reason than that bare Conjecture, *viz.* because they find the Stones to have a cleaving Grain, or that they are subject to cleave that Way of the Stone that lay horizontally in the Quarry: And for that Reason, if the horizontal Position of the Stones in the Quarry should be placed vertically in the Building, the super-incumbent Weight would be apt to cleave them, and so render the Building ruinous. For, as it has been observ'd by *Philip D'Orme*, the Breaking or Yielding of a Stone in the *Foundation*, although it should be but the Breadth of the Back of a Knife, it will make a Cleft of more than half a Foot in the Fabrick aloft. See *Stone-Bed*, and *Face of a Stone*.

In some Places they found the Peers of Bridges, and other Buildings near the Water, on Sacks of Wool laid like Matresses, which being well press'd and greasy, will never give way nor rot in Water.

How to value Foundations.

Mr. *Phillips* tells us there are several Ways of valuing *Foundations*, or Ground-Plots of Houses.

First,

First, Some value Buildings by their Length or Breadth towards the Street, reckoning every Foot in Front to be worth 4, 5, 6, 8, or 10*s.* yearly, according to the Street or Place they stand in; and this yearly Value they reckon at twenty Years Purchase; and at those Rates, every Foot in Front is worth 4, 5, 6, 8, or 10*l.*

But this is a very uncertain Way, by reason of the great Difference in the Depth of Houses, &c.

Secondly, Others value *Foundations* by their Length and Breadth, and measure them by the Foot, reckoning every Foot to be worth 3, or 4*s.* But this Method is as uncertain and fallible as the other.

For Ground being scarce and dear in the City of *London*, &c. each Foot of it there, may in some Places, be worth 8 or 10*s.* which in other Places of it shall not be worth half so much, and in the Country not half a Farthing, though you reckon Land at 20*s. per Acre*, and twenty Years Purchase; for at that Rate, it is worth but one Penny *per Yard*, and every Yard contains nine Feet.

Thirdly, But a certain Author (*viz.* Mr. *Wing*) prescribes a more certain and general Way of valuing these *Foundations*; which is by getting a true and indifferent Estimate of the yearly Rent the Houses formerly went at, at a moderate Rack-Rent, without any Abatement or Diminution of it by Fines, or any other Considerations; which being known, you may reckon the true Value of these *Foundations* to be four,

five, or six Years Purchase, according to the said yearly Rent, that is, about the third Part of the whole Worth or Purchase of the Fee-Simple of the House.

But in order to make a more exact Judgment and Valuation of the true Worth of *Foundations*, it will be best to distribute them into three Sorts, reckoning the first and lowest Sort of Houses, which yield least Rent, at four Years Purchase; the second Sort, which yield a moderate Rent, at five Years Purchase; and the third Sort, which yield the largest Rent, at six Years Purchase.

Mr. *Wing* attempts to demonstrate, that this Way of valuing *Foundations* is better, and to be preferred to any other.

The Foundations of Bridges.

Of all the Antients (says M. *Gautier*) in Architecture, who have given us any Rules for the founding of Bridges, *Scamozzi* is the only one that has said any Thing to the Purpose.

He tells us, that the *Foundations* are laid after different Manners.

The first is by enclosing all round the Space of Ground you would build upon, by Dams made with Piles set deep in the Ground in double Rows, well strengthened and bound together with cross Pieces and Cords, and filling the vacant Spaces between them with Chalk or other earthy Matter.

This being done, the Water must be empty'd out, and the *Foundation* digged according to the Quality of the Ground, driving down Piles, if it be necessary

cessary; upon which the Walls of the *Foundation* must be laid.

But this Method is only practicable in building on such Rivers where the Water is neither very rapid, nor very deep.

The second is done by laying the *Foundation* on Grate-Work, Rafts of stout Oak well bound together and made fast at the Surface of the Water with Cables or Machines, and building upon them large Quarters of Stone cramp'd together, and joined with good Mortar or Cement, and afterwards letting them descend softly by those Cables and Machines perpendicularly to the Bottom of the Water; as he says, was done in the Time of the Emperor *Claudius*, at the Port of *Ostia*; and as *Draguet Reys* did in the last Age at *Constantinople*, in the fine Mosque that he built upon the Sea. This Manner requires a good Bottom, equal and very even.

The third is by drawing off all or the greatest Part of the Water of the River into some other Place, or by digging it another Bed, or letting it out into deep Ditches; in which, says he, great Diligence must be used, to have all the Materials ready, and to have Workmen enough ready, sufficient to compleat it in a short Time, to the End that the Masonry may be well confirm'd and settled before there is a Necessity to let the River into its former Bed.

The last Method, which is that which *Scamozzi* says, he believes *Trajan* made use of in building a Bridge over the *Danube*, is to dig a new Bed for the River, in a Place which seems, as

it were, to meet itself, after having made a great Elbow or Compass about; which being done, the Bridge may be built with Ease, and that dry-shod, in that Place. And when the Bridge has been well settled, to open the Passage of the Current at the two Ends, stopping the Bed up with strong Banks or Moles, and so the River will take to its old Course again; this, says he, is the surest Method of all.

To lay the *Foundation* of the Piers of a Bridge, if the Earth be soft, it must be piled, after as much of it has been carried away as can well be. The same is to be done, if it be Sand or Gravel; which must be dug out as deep as can be, all round about, to a reasonable Distance; which must be surrounded with pointed Piles or Stakes well fastened to one another, filling the Spaces between Pile and Pile with Chalk or solid Earth well rammed in; which will for a Time, hinder the Current from washing away the Piles and Sand, and ruining the Work.

The Piles ought to be made tapering from Top to Bottom; the Arches unequal in Number, and carried up higher than the highest Inundation. The Architecture of Bridges ought to be plain and rustick.

Scamozzi afterwards gives the Design of his fine Bridge of Stone, and another of Carpentry. The Profile of this last may be seen in Monsieur *De La Hire's Treatise of Carpentry*.

M. *Blondel* relates the Method he made use of in laying the *Foundation*

Foundation of the Bridge of *Xaintes*, which he caused to be built over the *Charante*.

The ancient Bridge had been born down, it having been built on Potters Earth or Clay, and piled, so that the Swelling of the *Foundation* had raised the Piles, and threw down the Bridge. The Piles, by the Swelling of the Clay, started out above a Foot higher than the Level of the rest.

The Plummets went into this Clay, to the Depth of sixty Feet, made with a large Borer, the Arms of which were of Iron, each three Feet in Length, and well jointed one into another with good Pins.

After they had caused it to be dug seven Feet below the Bottom of the Water, all the Work being counterguarded and encompassed with a good Dam, and the Hollownests rak'd level, then a Grate-Work of good Oaken Wood was laid all over the *Foundation*, of twelve or fourteen Inches in Thickness, and square the whole Length and Breadth of the Building, not only that Part that was piled, but also the Opening or Space between the Piers and Abutments of the Bridge, or the void Spaces of the Arches.

The Chambers of the *Grille*, or Grate-Work, filled with good Quarters of hewn Stone, and the upper Part covered with Planks of five or six Inches thick, well fastened on with Pins all over the Grate-Work. Afterwards, upon this Work of Carpentry, is laid a *Foundation* of Masonry five Foot thick, all level, with

good hewn Stones well fastened together with Cramp-Irons.

Upon this flat *Foundation* of five Feet thick, the Piers are erected; which for the first Year are brought no higher than the Imposts, to the End that they may settle well during the Winter.

M. *Blondel* makes it appear, that whatever Precautions Architects take to secure their Works by good *Foundations*, yet they are very conjectural and uncertain.

He in this compares an Architect to a Physician, who proceeds only upon Conjectures.

For who can venture to say, says he, that building upon a *Foundation* of Consistence, as it appears to him to be, that he shall not meet with soft or bad Ground underneath; which the Weight of the Building will press down and sink into, and by that Means be overturn'd.

Upon this Occasion, says M. *Gautier*, I can give an Example that happen'd in one of the Isles of *Oleron*, or *Rhe*, where the King causing Fortifications to be built, one Face of the Wall sunk, or fell down, notwithstanding it was built on a Bank of Rock; because it had a Hollow underneath, which could not be, or was not discovered.

M. *Blondel* relates in Confirmation of what he has said, that the vast Walls of the Church of *Val de Grace*, sunk in on one Side, though built upon a good *Foundation*; because there were underneath large Hollows which had been made in former Times, for taking out of Stones some Fa-

thoms lower, there having been a Quarry there.

Michael Ange Bonarote caused the *Foundation* of the Dome of *St. Peter's* at *Rome* to be laid with all the Precautions imaginable. But for all that, this Work did gap or split, which they cured by binding it about with a Hoop of Iron of an extraordinary Breadth and Thickness, which cost above 100000 Crowns.

It is supposed, that this Fracture in the Dome is an Effect of the Waters of a subterraneous Source, from a Spring which runs down from the high Mountains of the *Vatican* and *Janiculus*, which have washed the *Foundations* of this huge Edifice. So that according to these Examples, no Body can be answerable for the *Foundations* of a Building.

The *Corderie* of *Rocheport*, the Design of *M. Blondel*, is in Length two hundred and sixteen Toises, not comprising the Pavillions that are at the two Ends, and four Toises, the Breadth between the Walls, to two Stories, built upon a *Grillage*, or Grate-Work, as well in the Full, as in the Void of ten or twelve Inches thick, laid upon a Bottom of Potters Clay.

Upon this *Grillage*, are laid Platforms well fastened together with Pins, and upon them a Couch or Course of hewn Stones, and good rough Stones, the Building being raised every where level continually, that it may be every where equal, that there may be no more Weight on the one Side than the other, that

all the Parts of the Work may be in *aequilibrio*. This Building thus raised, has succeeded perfectly well.

M. Blondel remarks further, that the Materials at *Paris* not being of the same Solidity as those of *Italy*, as perhaps Marble, and harder, will not permit to make Bridges at *Paris* with so much Delicacy, and so disengaged as those which are made in *Italy*; which have a great deal less Thickness at the Place of the Keys of the Arcades.

Artificial FOUNTAIN, a Machine whereby the Water is violently spouted or darted out, called by the *French* a *Jet d'Eau*.

Of these there are divers Kinds, some founded on the Pressure or Weight of the Water, and others on the Pressure or Weight of the Air.

The Construction of an artificial Fountain playing by the Pressure or Weight of the Water.

The Fund or Reservoir of Water must be placed considerably higher than the *Fountain* itself, (whether the Fund or Reservoir has been placed there by Nature, or whether it has been raised by Art for that Purpose by any Kind of Machine, as Pump, Siphon, or the like;) and from the Reservoir vertical Tubes must be laid for the Water to descend through; to which vertical Tubes horizontal ones are to be fitted under Ground, to convey the Water to the Place where the *Fountain* is to play.

Lastly, vertical Tubes must be erected from these horizontal ones,

ones, by way of Ajutages, Spouts, or Jets: Their Altitudes must be much less than that of the Tubes, whereby the Water was brought from the Reservoir to the horizontal ones.

If this be done, the Water will, by the Pressure of the superincumbent Column, be spouted up at these Jets, and that to the Height or Level of the Water in the Reservoir; and this will be, though the Tubes be bent and incurvated after any Manner whatsoever.

By this Means Water may be spouted to any given Height at Pleasure; and the Tubes may be so proportioned, as to yield any given Quantity of Water in a given Time; or several Tubes of the same *Fountain* may be made to yield Water in any given Ratio; or different Tubes may be made to project the Water to different Altitudes.

As for Instance: In a

Fountain that shall spout the Water in various Directions.

Suppose the vertical Tube or Spout, in which the Water rises, to be BA, [see the Plate, Fig. I.] into this fit several other Tubes, some horizontal, others oblique, some inclining, others reclining, as PO, NM, LF, &c. Then as all Water retains the Direction of the Aperture through which it is spouted, that issuing through B will rise perpendicularly; and that through H, L, P, N, E, will describe Arches of different Magnitudes, and tend different Ways.

Or thus: Suppose the vertical Tube BA, (see the Plate, Fig. II.) through which the Water rises, to be stopped at the Top, as in B, and instead of Pipes or Jets, let it be only perforated with little Holes all around, or only half its Surface; then will the Water spirt or spin forth in all Directions through the little Apertures, and to a Distance proportional to the Height of the Fall of the Water.

And hence, if the Tube BA be supposed to be the Height of a Man, and be furnished with a Cock at D, upon the opening the Cock, the Standers-by not being apprehensive of any such Thing, will be covered and surrounded with a Shower.

But here this is to be observed, that the Diameters of the Apertures out of which the Water is emitted, must be a great deal less than that of the Tube in which the Water is conducted, lest the Resistance of the Air and other Impediments break the Force of the Water.

A Fountain which spouts the Water in Manner of a Shower, is thus constructed.

To the Tube wherein the Water is to rise, fit a Head that is in the Form of a Sphere or Lens, as in the Plate, Fig. III. made of a Plate of Metal, and perforated at the Top with a great many small Apertures.

And then the Water rising with a great Force towards BA, will be there parted into innumerable little Threads, which

will afterwards break and disperse into the finest Drops.

The Construction of a Fountain, the Stream of which raises and plays a Brass Ball. See the Plate, Fig. IV.

Procure a hollow Globe or Ball made of thin Plate, whose Weight shall not be too heavy for the Force of the Water. Let the Tube CB, through which the Water rises, be exactly perpendicular to the Horizon.

Then let the Ball be laid in the Bottom of the Cup or Basin C, and it will be forced up by the Stream, and sustain'd at a considerable Height, as at A, vibrating alternately, or playing up and down.

And as the Figure of the Ball does not contribute any Thing to its rising and falling reciprocally, any other Body, in several other Forms, that are not too heavy, may be used instead of it, *e. g.* a Bird with its Wings stretched forth, &c.

But this Sort of *Fountain* should only be play'd in a Place that is not exposed to the Wind.

And it is also necessary, that the Ball, when on the Descent, should keep the same precise Perpendicular in which it rose, since otherwise it would miss the Stream, and fall downright.

The Construction of Fountains, which Spout Water out of the Figures of Men and other Animals.

Since Water may be deriv'd or convey'd by Tubes in any Si-

tuation, and always retains the Direction of the Apertures or Holes, all that is required in making such *Fountains*, is to inclose Tubes within the Figures of those Animals, having their Orifices in those Parts out of which the Water is to spout.

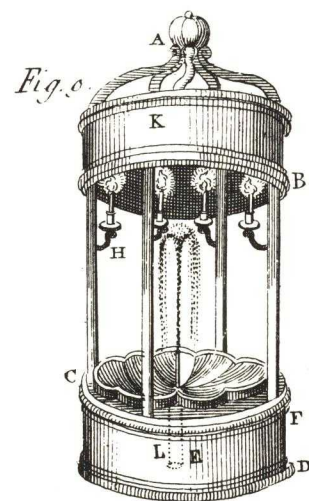
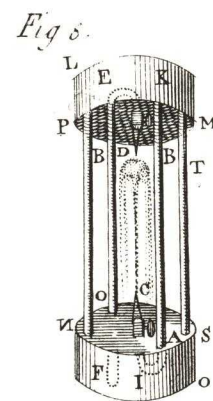
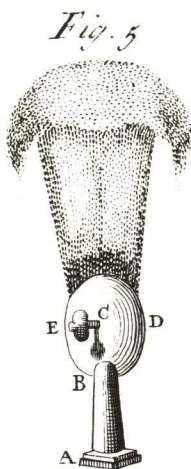
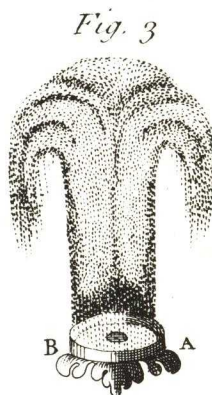
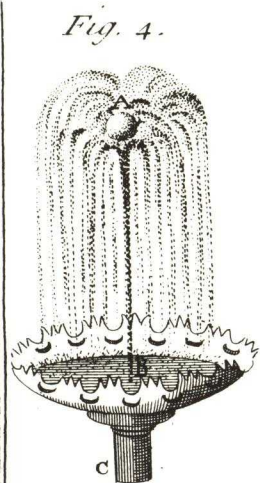
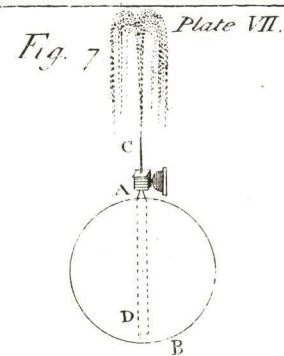
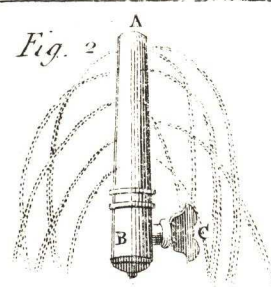
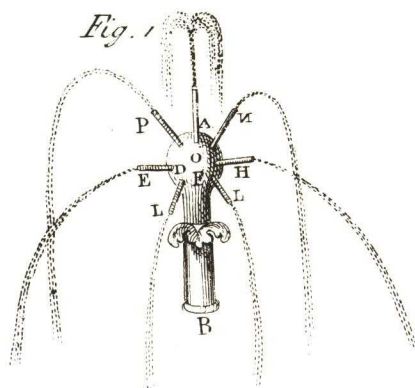
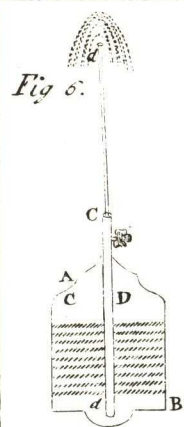
Therefore, from the Principles before laid down, it will be very easy to deduce whatsoever relates to the Furniture of *Fountains*, and the various Forms that Water may be put into by their Means: All which depend on the Magnitude, Figure, and the Direction of the Ajutages or Apertures.

The Construction of a Fountain which spreads the Water in the Form of a Cloth.

Solder two spherical Segments D and C to the Tube BA, Figure V. almost touching each other, with a Screw F, that so you may either contract or enlarge the Interstice or Chink between them at Pleasure.

Or you may make a smooth even Nitch in a spherical or lenticular Head, fitted upon the Tube; and then the Water spouting through the Chink or Nitch, will expand itself in manner of a Cloth.

So much may suffice, as to such *Fountains* as play by Means of the Pressure or Weight of the Water.



The Construction of an artificial Fountain, which plays by the Spring or Elasticity of the Air. See the Plate, Fig. VI.

Provide a Vessel of Metal, Glass, or the like, proper for a Reservoir, ending in a small Neck *d* at the Top.

Put the Tube *db* through this Neck, traversing the Middle of the Vessel till its lower Orifice *e* does almost, but not quite, reach the Bottom of the Vessel, the Vessel being first half fill'd with Water.

The Neck is to be so contriv'd, as that a Syringe or condensing Pipe may be screw'd upon the Tube; by Means of which a large Quantity of Air may be intruded through the Tube into the Water, out of which it will disengage itself, and emerge into the vacant Part of the Vessel, and lie over the Surface of the Water *DC*.

Now the Water here contain'd being thus press'd by the Air, which is, *e.g.* twice as dense as the external Air, and the elastick Force of Air being equal to its gravitating Force, the Effect will be the same as if the Weight, or the Column of Air over the Surface of the Water, were double that of the Column pressing in the Tube; so that the Water must of necessity spout up through the Tube, with a Force equal to the Excess of Pressure of the included, above that of the external Air.

The Construction of a Fountain which will play by the Draught of the Breath. See the Plate, Fig. VII.

Suppose a Sphere be made of Glass, or Metal, into which a Tube is fitted *DC*, having a little Orifice in *C*, and reaching almost to *D*, the Bottom of the Sphere; if now the Air be suck'd out of the Tube *DC*, and the Orifice *C* be immediately immersed under cold Water, the Water will ascend through the Tube into the Sphere.

Thus proceeding by repeated Exsuctions, till the Vessel be above half full of Water, and then applying the Mouth to *C*, and blowing Air into the Tube, upon removing the Mouth, the Water will spout forth.

Or, if the Sphere be put in hot Water, the Air being thereby rarefied, will make the Water spout out as before.

This Kind of *Fountain* is called *Pila Heronis*, i. e. *Hero's Ball*, from the Name of its Inventor.

The Construction of a Fountain, which, when it has done spouting, may be turned like an Hour-Glass. See the Plate, Fig. VIII.

Be provided with two Vessels, *ML* and *ON*, to be so much the bigger, as the *Fountain* is to play the longer; and placed at so much the greater Distance from each other *NP*, as the Water is desired to spout the higher.

Lct

Let BAC be a crooked Tube, furnished in C with a Cock; and FED, another crooked Tube, furnished with a Cock in D: In I and K let there be other lesser Tubes, open at both Ends, and reaching near to the Bottoms of the Vessels NO and LM, to which the Tubes QR and ST are likewise to reach.

If now the Vessel LM be filled with Water, it will descend through the Tube BA, and upon opening the Cock C, will spout up near to the Height of K: and after it is full again, will sink through the little Tube I into the Vessel NO, and expel the Air through the Tube QO.

At length, when all the Water is emptied out of the Vessel LM, by turning the Machine upside down, the Vessel NO will be the Reservoir, and make the Water spout up through the Cock D.

Hence, if the Vessels LM and NO contain just as much Water as will be spouted up in an Hour's Time, there will be a spouting Clepsydra, or Water Clock, which may be graduated or divided into Quarters, Minutes, &c. See the Figure.

The Construction of a Fountain which begins to play upon the lighting of Candles, and ceases as they go out. See Fig. IX.

Take two cylindrical Vessels AB and CD, and connect them by Tubes open at both Ends KL, BF, &c. so that the Air may descend out of the higher into the lower.

To the Tubes solder Candlesticks H, &c. and to the hollow Cover of the lower Vessel CF fit a little Tube or Jet FE, furnished with a Cock G, and reaching almost to the Bottom of the Vessels. In G let there be an Aperture furnished with a Screw, whereby Water may be poured into CD.

Then upon lighting the Candle, H, &c. the Air in the contiguous Tubes becoming rarefied thereby, the Water will begin to spout through EF.

By the same Contrivance may a Statue be made to shed Tears upon the Presence of the Sun, or the lighting of a Candle, &c. all that is here required being to lay Tubes from the Cavity wherein the Air is rarefied to some Cavities near the Eyes, and full of Water.

Vulgar FRACTIONS, *q. d.* a broken Number, in Arithmetick, is a Part or Division of an Unite or Integer; or it may be defined to be a Number that stands in Relation to an Unite, as a Part to its Whole.

Vulgar Fractions, also called *simple Fractions*, are always expressed by two Numbers, the one written over the other, with a short Line drawn between them.

The upper Number, which is called the *Numerator of the Fraction*, expresses the Parts given of the Denominator; and the lower Number, which is called the *Denominator of the Fraction*, denotes the Unite or Whole, which is divided into Parts.

Thus

Thus three Fourths of a Line, or other Thing, are written $\frac{3}{4}$, where the Denominator 4 shews that the whole Line is suppos'd to be divided into four equal Parts, and the Numerator 3 indicates, or assigns three of such Parts.

Again, seven Twelfths is written $\frac{7}{12}$, where the Numerator 7 expresses seven Parts of an Integer divided into twelve; and the Denominator 12 gives the Denomination of these Parts, which are called *Twelfths*.

In all *Fractions*, as the Numerator is to the Denominator, so is the *Fraction* itself to the Whole of which it is a *Fraction*.

Thus, supposing $\frac{3}{4}$ of a Pound equal to 15s. it is evident, that $3 : 4 :: 15 : 20$; whence it follows, that there may be infinite *Fractions* of the same Value with one another, inasmuch as there may be infinite Numbers found, which shall have the Ratio of 3 to 4.

Fractions are distinguished into *proper* and *improper*: A *proper Fraction* is one whose Numerator is less than its Denominator, and consequently the *Fraction* less than the Whole, or Integer, as $\frac{2}{12}$.

An *improper Fraction* is one whose Denominator is either equal to, or bigger than the Denominator; and consequently the *Fraction* equal to, or greater than the Whole, as $\frac{12}{12}$ or $\frac{13}{12}$.

Fractions are also distinguish'd into *simple* and *compound*: *Simple Fractions* are such as consist of one Numerator and one Denominator, as $\frac{3}{12}$, $\frac{26}{1+4}$, &c.

Compound Fractions are such as consist of several Numerators and Denominators, as $\frac{1}{2}$ of $\frac{3}{4}$, of $\frac{1}{2}$, &c. These are also called *Fractions of Fractions*.

The Arithmetick of *Fractions* consists in *Reduction*, *Addition*, *Subtraction*, *Multiplication*, and *Division*.

I. *Reduction of Fractions.*

First, To reduce a given whole Number into a *Fraction* of any given Denominator;

Multiply the given Integer by the given Denominator, and the Factum will be the Numerator.

Thus we shall find $3 = \frac{24}{8}$, and $5 = \frac{30}{6}$, and $7 = \frac{35}{5}$.

If no Denominator be given, the Number is reduced to a *Fraction* by writing 1 under it as a Denominator, as $\frac{2}{1}$, $\frac{3}{1}$, $\frac{1}{1}$.

Secondly, To reduce a given *Fraction* to its lowest Terms, *i.e.* to find a *Fraction* equivalent to a given *Fraction*, as $\frac{12}{48}$, divide both the Numerator 12, and the Denominator 48 by some one Number that will divide them both without any Remainder, as here by 4, the Quotients 3 and 12 make a new *Fraction*, as $\frac{3}{12}$ are equal to $\frac{12}{48}$.

And if the Division be performed by the greatest Number that will divide them both, then will the *Fraction* be reduced into its lowest Terms.

Now to find the greatest common Divisor of two Quantities, divide the greater by the less; then divide the Divisor of the Division by the Remainder thereof. Again, divide the Divisor

of

F R

of the second Division by the Remainder of the second, and so on till there remain nothing; and the last Divisor will be the greatest common Measure of the given Numbers.

If it happen that Unity is the only common Measure of the Numerator and Denominator, then the *Fraction* cannot be reduced any lower.

Thirdly, To reduce two or more *Fractions* to the same Denomination, *i. e.* to find *Fractions* equal to the given ones, and with the same Denominators;

If only two *Fractions* be given, multiply the Numerator and Denominator of each into the Product of the Denominator of the other, and the Products given will be the new *Fractions* required.

Thus $5 \frac{2}{3}$, and $3 \frac{4}{5}$, make $\frac{10}{3}$ and $\frac{12}{5}$: If more than two be given, multiply both the Numerator and Denominator of each into the Product of the Denominators of the rest: Thus $24 \frac{3}{4}$, $12 \frac{1}{6}$, $18 \frac{2}{3}$, are $= \frac{42}{2}$, $\frac{4}{2}$, $\frac{72}{2}$.

Fourthly, To find the Value of a *Fraction* in the known Parts of its Integer; *e. gr.* As suppose it were required to know what is the Value of $\frac{9}{16}$ of a Pound, multiply the Numerator 9 by 20, and divide the Product by the Denominator 16, and the Quotient will be 11 s.

Then multiply the Remainder 4 by 12, the Number of known Parts in the next inferior Denomination; and dividing the Product by 16, as before, the Quotient will be 3 d. so that $\frac{9}{16}$ of a Pound is = 11 s. 3 d.

Fifthly, To reduce a mix'd Number, as $6 \frac{1}{12}$, into an im-

F R

proper *Fraction* of the same Value;

Multiply the Integer 6 by 12, the Denominator of the *Fraction*, and to the Product 72 add the Numerator: The Sum 83 set over the former Denominator $\frac{83}{12}$, constitutes the *Fraction* required:

Sixthly, To reduce an *improper Fraction* into its equivalent mix'd Number.

Suppose the given *Fraction* to be $\frac{43}{12}$, divide the Numerator by the Denominator, and the Quotient $3 \frac{7}{12}$ is the Number sought.

Seventhly, To reduce a compound *Fraction* into a simple one, multiply all the Numerators into each other, for a new Numerator; and all the Denominators for a new Denominator thus, $\frac{1}{2}$ of $\frac{2}{4}$ of $\frac{2}{6}$ will be $\frac{1}{48}$.

II. Addition of Vugar Fractions.

First, If the given *Fractions* have different Denominators, reduce them into the same; then add the Numerators together, and under the Sum write the common Denominator, thus, *e. g.*
 $\frac{2}{3} + \frac{4}{5} = \frac{10}{15} + \frac{12}{15} = 1 \frac{22}{15}$, and $\frac{2}{3} + \frac{1}{6} + \frac{3}{4} = \frac{4}{6} + \frac{3}{6} + \frac{9}{12} = 1 \frac{42}{12} = 1 \frac{7}{2}$.

Secondly, If compound *Fractions* are given to be added, they must first be reduced to simple ones: and if the *Fractions* be of different Denominations, as $\frac{2}{8}$ of a Pound, and $\frac{3}{4}$ of a Shilling, they must be first reduced to *Fractions* of the same Denomination of Pounds.

Thirdly, To add mix'd Numbers, the Integers are first to be added

added, then the Fractional Parts; and if their Sum be a proper Fraction, only annex it to the Sum of the Integers.

If it be an improper Fraction, reduce it to a mix'd Number, adding the Integral Part thereof to the Sum of the Integers, and the Fractional Part after it, as $5\frac{2}{3} + 4\frac{2}{3} = 10\frac{1}{2}$.

III. Subtraction of Fractions.

First, If they have the same common Denominator, subtract the lesser Numerator from the greater, and set the Remainder over the common Denominator.

Thus from $\frac{2}{12}$ take $\frac{1}{12}$, and there will remain $\frac{1}{12}$.

Secondly, if they have not a common Denominator, they must be reduced to Fractions of the same Value, having a common Denominator; and then as in the first Rule,

Thus $\frac{6}{7} - \frac{2}{3} = \frac{30}{21} - \frac{14}{21} = \frac{16}{21}$.

Thirdly, To subtract a whole Number from a mix'd Number, or one mix'd Number for another, or reduce the whole, or mix'd Numbers to improper Fractions, then proceed, as in the first and second Rule.

IV. Multiplication of Fractions.

First, If the Fractions propos'd be both single, multiply the Numerators one by another for a new Numerator, and the Denominators for a new Denominator.

Thus $\frac{3}{4}$ being multiply'd by $\frac{7}{8}$, produces $\frac{21}{32}$.

Secondly, If one of them be a

mix'd, or whole Number, it must be reduced to an improper Fraction; and then you are to proceed as in the last Rule,

Thus $\frac{5}{3}$ being multiply'd into $\frac{10}{1} = \frac{50}{3}$.

In Multiplication of Fractions, it is to be observ'd, that the Product is less in Value, than either the Multiplicand and Multiplier; because in all Multiplications, as Unity is to the Multiplier, so is the Multiplicand to the Product.

But Unity is bigger than either Factor, if the Fractions be proper; and therefore either of them must be greater than the Product.

Thus, in whole Numbers, if 5 be multiply'd by 8, it will be as 1 : 5 :: 8 : 40; or 1 : 8 :: 5 : 40.

Wherefore in Fractions also, as $1\frac{3}{4} : 1 :: \frac{3}{4} : \frac{1}{3\frac{1}{2}}$; or as $1 : \frac{3}{8} :: \frac{3}{4} : \frac{1}{2}$.

But 1 is greater than either $\frac{3}{4}$ or $\frac{3}{8}$; wherefore either of them must be bigger than $\frac{1}{2}$.

V. Division of Fractions.

First, If the Fractions propos'd be both single, multiply the Denominator of the Divisor by the Dividend, and the Product will be the Numerator of the Quotient.

Then multiply the Numerator of the Divisor by the Denominator of the Dividend, and the Product will be the Denominator of the Quotient,

Thus $\frac{2}{3} \div \frac{3}{7} = \frac{14}{9}$.

Secondly, If either Dividend, Divisor, or both, be whole, or mixed

mixed Numbers, reduce them to improper *Fractions*; and if they be compound *Fractions*, reduce them to simple ones; and then proceed as in the first Rule.

In Division of *Fractions* it is to be observ'd, that the Quotient is always greater than the Dividend; because in all Division, as the Divisor is to Unity, so is the Dividend to the Quotient; as if 3 divide 12, it will be as 3 : 1 :: 12 : 4.

Now 3 is greater than 1; wherefore 12 must be greater than 4; but in *Fractions*, as $\frac{3}{2} : 1 :: \frac{4}{3} : \frac{2}{3}$, where $\frac{3}{2}$ is less than 1; wherefore $\frac{4}{3}$ must be also less than $\frac{2}{3}$.

FRAMING of an *House*, is the Carcase, Flooring, Partitioning, Roofing, Ceiling, Beams, Athlring, &c. all together.

As to the Carcase of a House, Mr. *Leybourn* says, that Carpenters commonly work by the Square of ten Feet in erecting the Carcase, that is, (as he says) the *framing* and setting up, with the Partitions, Floors, Rafters, and such like; for which, he says, they have in running Buildings from 15 to 20 s. the Square, and some may deserve 30 s. or more. And he adds, that to a Square of good Carcase, 20 Feet of Ground-Roof Timber may be allowed: But it does not appear, whether he means that the Carpenter fells, hews, and saws the Timber into that Price.

Some *Suffex* Workmen have said, that they have but 8 s. per Square for *framing* the Carcase of a House, and sawing the Timber; and but 4 s. 6 d. without sawing the Timber.

As to the Carcase of a Barn: Some Workmen say, that they have for *framing* of Barns 3 s. 6 d. per Square; and that the Charge of the Carcase of a Barn may be thus computed, viz. 4 s. per Square for sawing the Boards, considering the Slabbing and the Boards lying over one another; 2 s. per Square for sawing the Timber; 3 s. 6 d. per Square for *framing*; and 4 s. per Square for the Timber, reckoning at 12 s. per Ton, and one Ton to make three Square of *Framing*: So that the whole Charge of the Carcase will be at least 13 s. 6 d. per Square; but if the Timber be more than 12 s. per Ton, then the whole Charge will be more than what has been before mentioned.

Partitions: Though indeed some Workmen reckon Partitions into the Carcase, yet others reckon for them by themselves; for which, and sawing the Timber, some say they have 6 or 7 s. per Square, and for the Workmanship only, but 4 s. 6 d. per Square.

Roofs: Mr. *Leybourn* says, that Carpenters commonly reckon 4 or 5 s. in the Square more for *framing* of Roofs, than for the rest of the Building.

But some *Suffex* Workmen say, that for *framing* Roofs, and sawing the Timber, they have no more than 8 or 9 s. per Square; and for the Workmanship, only 4 s. 6 d. per Square.

Thorough Framing, is *framing* and making all Doors and Windows. This, some Workmen say, they have 5 s. a Square for the Workmanship only.

By

By the Great Square : A Term used by Carpenters, who sometimes work by the Great Square in Brick Buildings ; and then besides *framing* the Floors, Partitions, Roof, &c. they also make Doors, Windows, Cornices, Stair-Cases, and (in general) all that is Carpenters Work, and sawing of Timber, (except Modillions or Cantalivers,) for which Work they have 6*l.* per Square.

But this is to be noted, that in this Way of Working they measure only the Ichthyography or Ground-Plot, only to the Dimensions they add one of the Projectures in Front, and not in Flank, and so cast it up.

This Sort of Work is measured by the Square, as *Floors*.

FREEZE } in Architecture,
FRIEZE } is properly a large flat Face or Member, separating the Architrave from the Cornice, and that Part of the Entablature between the Architrave and Cornice.

This Member was called by the Antients *Zoophorus*, because it was commonly enriched with the Figures of Animals.

Frieze is said to be formed from the *Latin*, *Phrygio* an Embroiderer, because usually adorned with Sculptures in *Basso Relievo*, imitating Embroidery.

The *Frieze* is supposed to be designed to represent the Heads of the transverse Beams which sustain the Roof or Covering.

This Member is quite plain in the *Tuscan* Order ; but is enriched with Triglyphs in the *Doric* : Is sometimes made arch'd or swelling in the *Ionic*, in which Case particularly, *Vitruvius* calls it

Pulvinatus, *q. d.* pillowed. In the *Corinthian* and *Composite*, it is frequently joined to the Architrave by a little Sweep, and sometimes to the Cornice : And in these richer Orders, it is commonly adorned with Sculpture, Figures, Compartiments, Histories, Foliages, Festoons, &c.

As to the Height of the *Frieze*, it is in the general much the same as that of the Architrave.

Vitruvius makes the *Tuscan Frieze* flat and plain, and in Height 30 Minutes.

Palladio, who makes it convex or swelling, gives it but 26 Minutes : And *Scamozzi* makes it plain, and in Height 42 Minutes.

The *Doric* : *Vitruvius* and *Vignola* make this *Frieze* flat, only carved with Triglyphs and Metopes, and its Height 30 or 40 Minutes. And *Palladio* and *Scamozzi* make it like *Vitruvius*, and in Height 45 Min.

The *Ionic* : *Vitruvius* makes this *Frieze* flat, only carved with Acanthus Leaves, Lions, Men, &c. and in Height 30 Min. *Vignola*, he also makes it flat, and allows it 45 Min. And *Palladio*, who makes it convex or swelling, 27, and *Scamozzi* 28.

The *Corinthian* *Vitruvius* enriches with Acanthus, human Figures, &c. and makes its Height 37 Min. *Vignola* 45, *Palladio* 28, and *Scamozzi* 31 $\frac{3}{4}$.

Lastly, the *Composite* : This in *Vitruvius* is set with Cartouches, and carved between them, is 52 $\frac{1}{2}$ Min. *Vignola* makes it like *Vitruvius*, but gives it but 45 Min. *Palladio*, who makes it swelling, has but 30, and *Scamozzi* 32.

From these Variety of Inrichments which adorn the *Freezes*, they obtain various Denominations.

Convex Freezes } are such
Pulvinated Freezes } whose Profile is a Curve; the best Proportion of which, is when drawn on the Base of an equilateral Triangle.

In some the Swelling is only at Top, as in a Console; in others at Bottom, as in a Baluster.

Flourish'd Freezes are such as are enrich'd with Rinds of imaginary Foliages; as the *Corinthian Freeze* of the Frontispiece of *Nero*; or with natural Leaves, either in Clusters or Garlands; or continued as in the *Ionic* of the Gallery of *Apollo* in the *Louvre*.

Historical Freezes are such as are adorn'd with Bass Relievo's, representing History, Sacrifices, &c. as the Arch of *Titus* at *Rome*.

Marine Freezes are such as represent Sea-Horses, Tritons, and other Attributes of the Sea; or Shells, Baths, Grotto's, &c.

Rustic Freezes are such whose Courses are rusticated or imboss'd, as in the *Tuscan Freeze* of *Palladio*.

Symbolical Freezes are those adorned with the Attributes of Religion, as the *Corinthian* of the Temple behind the Capital at *Rome*, whereon are represented the Instruments and Apparatus of Sacrifice.

We sometimes, says M. Le Clerc, make the *Frieze* of the Entablature convex; but then this should never be done without some good Reason, mere

Caprice being not sufficient to warrant such an Alteration.

When one Order is raised over another, and the upper Column has its due Bigness, its Pedestal nevertheless goes beyond the Naked of the under Column, which to some Persons has a disagreeable Effect.

This, says he, inclines me to think, that the first Architect who made a convex *Frieze*, did it with a Design to extenuate this Appearance of a Defect.

This is evident, that as the Naked of a *Frieze* is hidden by this Swelling, the Pedestal of the upper Order appears less, to exceed the Naked of the under Order, as may be easily observed where the two Orders are seen over each other. Were it not on this Account, the convex *Frieze*, just mentioned, ought not, says he, in my Opinion, to be imitated: The *Frieze* may be made convex in all the Orders except in the *Doric*, where this Swelling can't be allow'd, by reason of the Triglyphs.

FRESCO, a Method of Painting, or rather Plastering on Walls to endure the Weather, and representing Birds, Beasts, Herbs, Fruits, &c. in Relief.

It is performed on fresh Plaster, or on a Wall laid with Mortar, not yet dry, and with Water Colours.

This Sort of Painting has a great Advantage by its incorporating with the Mortar, and drying along with it, it is rendered extreme durable, and never fails or falls but along with it.

Of the Method of this Painting: To make the Compost or Plaster of old rubbish Stones, and

and mix it with well-burnt Flint (or Lime) and Water; but wash out the Saltness of the Lime, by often pouring the Water, and putting fresh to it. This should not be done in moist Weather, because that has a great Influence on the Walls.

And in order to render the Plaster the more durable, they strike into the Joints of the Brick or Stone Wall Stumps of Horse Nails, at about six Inches Distance, to prevent the Plaster from peeling off.

With this Plaster the Wall is first to be plastered a good Thickness, and left for some Time to dry; and the Design and Colours being first ready prepared.

This Painting is chiefly performed on Walls and Vaults newly plastered with Lime and Sand; but the Plaster is only to be laid in Proportion as the Painting goes on, no more being to be done at once than the Painter can dispatch in a Day, while it is dry.

Before the Painting is begun, there is usually a Cartoon or Design made on Paper, to be calk'd and transferred to the Wall, about half an Hour after the Plaster has been laid on.

The Colour being prepared and mingled, the Wall is to be plastered over again a second Time about the Thickness of Half-a-Crown, but only so much as you intend presently to Work upon; and while it is wet, you must work the Colours therein, which will mix and incorporate with the Plaster, so as never to wash out.

The Painting must be, for the Work to come out in all its
VOL. I.

Beauty, wrought quick, and with a free Hand; for there can be no Alteration after the first Painting, and therefore make your Colour high enough at first; you may deepen, but not easily heighten.

Nor must they ever be retouch'd dry, with Colours mix'd up with the White of an Egg, or Size or Gum, as some Workmen do, by reason such Colours grow blackish; nor do any preserve themselves, but such as were laid on hastily at first.

In this Painting all the compound and artificial Colours, and almost all the Minerals are set aside, and scarce any Thing used but Earths; which are capable of preserving their Colour, defending it from the burning of the Lime, and resisting its Salt, which *Vitruvius* calls its Bitterness.

The Colours used are White made of Lime slack'd long ago, and white Marble Dust; Oker, both red and yellow, Violet Red, Verditer, Lapis Lazuli, Smalt, Earth, black Spanish Brown, Spanish White, &c. All which are only ground and work'd up with Water; and most of them grow brighter and brighter as the *Fresco* dries.

The Brushes and Pencils for this Work must be long and soft, or else they will rake and raze the Painting: The Colours must be full, and flowing from the Brush; the Design perfect in the Image or Paper Copy; for in this Work you cannot alter or add upon any Colour.

This Sort of Painting has a great Advantage, by its incorporating with the Mortar, and drying
C c ing

ing along with it, is rendered extremely durable, and never fails nor falls but along with it.

The Antients painted on Stuck; And it is worthy Observation in *Vitravius*, what infinite Care they took in making the Incrustation or Plaistering of their Buildings, to render them beautiful and lasting: Though the modern Painters find a Plaster made of Lime and Sand preferable to Stuck, both because it does not dry too hastily, and as being a little brownish, it is fitter to lay Colours on, than a Ground so white as Stuck.

This Kind of Painting was the antient *Grecian* Way of Painting, and since much used by the *Romans*.

Plutarch informs us, that *Aratas*, the great Commander under *Ptolemy* King of *Egypt*, (in a Compliment to the Emperor's Affections that Way,) forbore to sack a wealthy City, merely for the Excellency of the *Fresco* Painting upon the Walls of the Houses.

There have been several whole Towns of this Work in *Germany*, excellently well done, but now ruin'd by Wars.

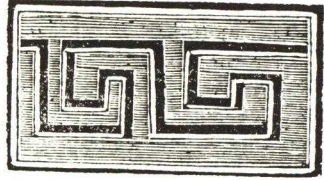
At *Rome* there are three Chambers (in the *Popes* Palace) of *Fresco*, done by *Raphael Urbiz*, and *Julio Romano*. (his Disciple) who finished his Master's Work, which is yet called *Raphael's* Design.

There are other Places done by *Andrea del Sexto* and *Michael Angelo*, and some other Artists.

There is an excellent *Fresco* Work at *Fountainbleau* in *France*. It is the continued Travels of *Ulysses*, in sixty Pieces, done by

Bollmneo Martin Rouse, a *Florentine*, and others.

FRET } in Architecture,
FRETTE } is a Kind of Knot or Ornament, consisting of two Lifts or small Fillets va-



riously interlaced or interwove, and running at parallel Distances equal to their Breadth.

Every Return and Interfection of these *Frets* must be at Right Angles. This is so indispensibly necessary, that they have no Beauty without it, but become perfectly *Gothic*.

Sometimes the *Fret* consists but of a single Fillet, which however may be so ordered, as to fill its Space exceedingly well, if well managed.

These *Frets* were very much in use among the Antients, who apply'd them chiefly on even flat Members, or Parts of Buildings; as the Faces of the Corona, and Eaves of Cornices; under the Roofs, Soffits, &c. on the Plinths of Bases, &c.

The Name *Frette* was hence occasion'd, that *Frette* literally signifies the Timber-Work of a Roof; which consists chiefly of Beams, Rafter, &c. laid across each other, and, as it were, *fretted*.

FRET-WORK, an Enrichment of *Frette*, or a Place adorned with something in the Manner thereof.

Fret-

Fret-Work is sometimes used for the filling up and enriching flat empty Spaces, but it is principally practised in Roofs which are *fretted* over with Plaster-Work.

The *Italians* also use *Fret-Work* in the Mantlings of Chimneys with great Figures, a cheap Piece of Magnificence, and as durable almost within Doors, as harder Matters in the Weather.

FRICITION, in Mechanicks, is the Resistance which a moving Body meets withal from the Surface on which it moves.

Fricition is produced by the Asperity or Roughness of the Surface of the Body mov'd on, and that of the Body moving.

For such Surfaces consisting alternately of Eminencies, and Cavities, either the Eminencies of the one must be raised over those of the other, or they must be both broken or worn off: But neither of these can happen without Motion; nor can Motion be produced without a Force impress'd.

Hence the Force apply'd to move the Body is either wholly or partly spent on this Effect, and of Consequence there arises a Resistance or *Fricition*, which will be be greater, *ceteris paribus*, as the Eminencies are the greater, and the Substance the harder.

And as the Body by continual *Fricition* grows more and more polish'd, the *Fricition* diminishes.

Hence it follows, that the Surfaces of the Parts of Machines, which touch each other, ought to be as smooth and polish'd as possible.

But as no Body can be so much polish'd, as to take all Inequality quite away; witness those numerous Ridges which may be discover'd by the Help of a Microscope on the smoothest Surfaces; hence arises the Necessity of anointing the Parts that touch with Oil, or other fatty Matter.

The Laws of *Fricition* are,
First, As the Weight of a Body moving on another, is increased, so is its *Fricition*.

This is experimentally seen in a Balance; which when only charged with a small Weight, easily turns; but with a greater, a greater Force is required.

Hence if the Line of Direction of a moving Body be oblique to the Surface moved on, the *Fricition* is the greater; this having the Effect as the Increase of Weight.

And hence again, as a perpendicular Stroke or Impression is to an oblique one; as the whole Sine is to the Sine of the Angle of Incidence; and the Sine of the greater Angle is greater, and that of the lesser less; the *Fricition* is greater, as the Line of Direction approaches nearer to a Perpendicular.

This is easily observable, and especially in the Teeth of Wheels, which are frequently broke on this very Account.

The *Fricition* therefore is taken away, if the Line of Direction of the moving Body be parallel to the Surface.

Secondly, The *Fricition* is less in a Body that rolls, than it would be, were the same Body

to slide ; as is easily demonstrated.

For suppose a dented Ruler, and suppose a dented Wheel to move along it, with its Teeth perpendicular to the Circumference :

If now the Body were to slide, the Tooth, when it touch'd the Ruler, would describe a Right Line on the Surface thereof ; and as the Tooth of the Ruler resists the same, it could not proceed without either removing or breaking either the Tooth of the Wheel, or its own. And the same will hold of the sliding of any rough Surface upon another, where all the *Friction* will take Place, that can any way arise from the Roughness of the Surface.

But if the Wheel roll along the Ruler, then the Tooth will no longer resist its Motion, only as it is to be hoisted out of the Cavity over the Eminence of the Tooth ; and the same holds in the rubbing of any rough Body over the Surface of another.

Hence in Machines, least the *Friction* should employ a good Part of the Power, Care is to be taken that no Part of the Machine slide along another, if it can be avoided, but rather that they roll or turn upon each other.

With this View, it may be proper to lay the Axes of Cylinders, not as is usually done in a Groove, or concave Matrix, but between little Wheels moveable on their respective Axes.

This was long ago recommended by *P. Casatus* ; and it is con-

fir'd by Experience, that a great deal of Force is saved by it.

Hence also it is, that a Pulley moveable on its Axis, resists less than if it was fixed ; and the same may be observ'd of the Wheels of Coaches, and other Carriages.

From these Principles, with a little further Help from the Higher Geometry, *Olaus Roemer* determin'd the Figure of the Teeth of Wheels, that should make the least Resistance possible, and which would be Epicycloidal ; and the same was afterwards demonstrated by *M. De La Hire*. Though the Thing is not yet taken into Practice.

Hence, in Sawing-Mills, the Sides of the Wooden Rectangle, the Saws are fitted into, should be furnish'd with Rotules or little Wheels, which would greatly lessen the *Friction* ; and the like in other Cases. Add, that as Winches, or curved Axes prevent all *Friction*, those should be used instead of Wheels, as often as possible.

The Calculation of the Quantity or Value of Friction.

Tho' *Friction* is a Point of the utmost Importance in Machines, and by all Means to be considered in calculating the Force thereof ; yet it is generally overlook'd in such Calculations : But this, principally, by reason the precise Value is not known.

It is not yet reduced to certain and infallible Rules. The common Method is barely to compute what the Advantage is which a moving Power has from
the

the Machine, either on account of its Distance from a fixed Point, or of the Direction in which it acts. And in all the Demonstrations, it is supposed, that the Surfaces of Bodies are perfectly smooth and polish'd.

Indeed, the Engineers expect that in the Practice they should lose Part of the Advantage of their Force by their *Friction*; but how much it is supposed, nothing but the Practice can determine.

M. *Amontons*, indeed, has made an Attempt to settle by Experiment a Foundation for a precise Calculation of the Quantity of *Friction*; and M. *Parent* has confirm'd it by Reasoning and Geometry: But their Theory, however warrant'd, is not generally and fully received.

M. *Amontons*'s Principle is, that the *Friction* of two Bodies depend on the Weight or Force wherewith they bear on each other; and only increases as the Bodies are more strongly press'd and apply'd against each other; or are charged with a greater Weight; and that it is a vulgar Error, that the Quantity of *Friction* has any Dependance upon the Bigness of the Surfaces rubb'd against each other; or that the *Friction* increases as the Surfaces do.

Upon the first Proposal of this Paradox, M. *De La Hire* had Recourse to Experiments, which succeeded much in Favour of the new System.

He laid several Pieces of rough Wood on a rough Table: Their Sizes were unequal; but he laid Weights upon them, so as to render them all equal-

ly heavy, and he found that the same precise Force or Weight apply'd to them, by a little Pulley, was required to put each in Motion, notwithstanding all the Inequality of the Surfaces. The Experiment succeeded in the same Manner, in Pieces of Marble laid on a Marble Table.

Upon this M. *De La Hire* apply'd himself to consider the Rationale of the Thing; and has given us a Physical Solution of the Effect. And M. *Amontons* settl'd a Calculus of the Value of *Friction*, and the Loss sustained thereby in Machines, upon the Footing of the new Principle.

In Wood, Iron, Lead, and Brass, which are the principal Materials used in Machines, he finds the Resistance caused by *Friction* to be nearly the same, when those Materials are anointed with Oil, or other fatty Matter: And this Resistance, independent of the Quantity of the Surface, he makes to be nearly equal to a third Part of the Force wherewith the Bodies are pressed against each other.

Beside the Pressure, the Magnitude whereof determines that of the *Friction*, there is another Circumstance to be considered, viz. Velocity.

The *Friction* is the greater, and the more difficult to surmount, as the Parts are rubb'd together with the greater Swiftness: So that this Velocity must be compared with that of the Power necessary to move the Machine, and overcome the *Friction*.

If the Velocity of the Power be double that of the Parts rubb'd, it acquires by that Means

an Advantage, that makes it double, or, which amounts to the same, diminishes the contrary Force of *Friction* by one half, and reduces it to a sixth Part of the Weight or Pressure.

But this Velocity, M. *Amon-ton* only considers as a Circumstance that only augments or diminishes the Effect of the Pressure, *i. e.* the Difficulty of the Motion; so that the *Friction* still follows the Proportion of the Weight.

Only we are hereby directed to dispose the Parts of Machines that rub against each other in such Manner, as that they may have the least Velocity possible. And thus the Diameter of the Axis of a Wheel should be as small as possible, with Regard to that of the Wheel, in that the lesser the Axis, the slower will be Motion of the Surfaces rubbing against each other, since the Velocity of a circular Motion always goes diminishing from the Circumference to the Centre.

And for the same Reason, the Teeth of dented Wheels should be as small and as thin as possible; for a Tooth catching on a Notch, &c. rubs one of its Sides against a Surface equal to its own; and is to disengage itself in a certain Time by passing over a Space equal to the Surface; consequently the less the Surface, the less Space it has to move, the Littleness of the Surface diminishing the Resistance of the *Friction*; not that it is a less Surface that rubs, but as there is a less Space to move.

But notwithstanding all the

Confirmations and Illustrations of the Theory of *Friction*, the Publick, nor even the Academy itself, where it was proposed, could not be brought fully to acquiesce in it.

It is granted, the Pressure has a great Effect, and is, in many Cases, the only Thing to be considered in *Frictions*. But it will be hard to persuade us absolutely to exclude the Consideration of the Surface. And in Effect, the contrary seems capable of a Metaphysical Demonstration.

If two Bodies with plain Surfaces, suppos'd infinitely hard and polish'd, be moved along each other, the *Friction* will either be none, or infinitely small: But if instead of such Supposition, which has no Place in Nature, we suppose two Bodies with rough uneven Surfaces, the Difficulty of moving one of them upon the other must arise either from this, that the first must be raised, in order to disengage the Parts, catch'd or lock'd into the second; or that the Parts must be broke or worn off, or both.

In the first Case, the Difficulty of raising one of the Bodies, makes that of the Motion; and of consequence the *Friction* arises wholly from the Weight or Pressure, and the Surface has nothing to do.

In the second Case, the Magnitude of the Surface would be all, were it possible this second Case could be absolutely extracted from the first, *i. e.* could the Parts of one Body be rubb'd and worn against those of the other, without raising one of them; it being visible, that a greater Number

ber of Parts to be broke would make a greater Resistance than a less.

But as in Practice, we never rub or grind without raising the Body, the Resistance arising from the Greatness of the Surface, is always combin'd in the second Case with that of the Pressure; whereas in the former Case, that, arising from the Pressure, may be alone, and uncompounded.

Add to this, that what is wore off a Body, is ordinarily very little, with Regard to the great Number of Times the Body must have been raised during the *Friction*, and all the little Heights added together, which the Body must have been raised to.

Hence as the Resistance from Pressure may be single, and as the same always accompanies that arising from the Magnitude of the Surfaces, and is usually the much more considerable of the two, when it does accompany it; for these Reasons, in most of the Experiments that are made, it is the only one perceived, and the only one that needs to be considered.

But then, as 'tis possible, in certain Cases for the Pressure to be very slender, and the Number of Parts to be rubb'd, very great, it must needs be own'd, there are Cases wherein the *Friction* follows very sensibly the Proportion of the Surfaces.

FRIEZE, } in Architecture,
FRIZE, } is a Member or
FREEZE, } Division of the
Entablature of Columns, by the
Antients called *Zoophorus*.

FRIGERATORY, a Place

to make or keep Things cool in Summer.

FRONT, in Architecture, is the principal Face or Side of a Building, or that which is presented to the chief Aspect or View.

Of Setting of Fronts.

The *Setting* (that is making) of the *Frents* of great Buildings, viz. Ashlar (or Stones) Architrave Windows, or Doors, with the Ground-Table, Fascias, and other Members, (Mr. *Wing* says) are worth from 3*l.* 10*s.* to 5*l.* per Rod, according to the Goodness of the Work.

Front, in Perspective, is a Projection or Representation of the Face or Forepart of an Object, or of that Part directly opposite to the Eye; which is more usually called the *Orthography*.

FRONTAL, a little Fronton or Pediment, sometimes placed over a little Door or Window.

FRONTISPIECE, in Architecture, the Portrait, or principal Face of a Building.

FRONTON, in Architecture, an Ornament which is more usually called among us, *Pediment*.

FROMEY. Workmen say Timber is *frowey*, when it is evenly tempered all the Way, and works freely without tearing.

FRUSTUM, in Mathematics, a Piece cut off, and separated from a Body. Thus the *Frustum* of a Pyramid, or Cone, is a Part or Piece of it cut off usually by a Plane parallel to the Base.

F R

Frustrum of a Pyramid, is the remaining Part, when the Top is cut off by a Plane parallel to the Base.

To find the solid Content, there are several Rules:

R U L E I.

To the Rectangle, (or Product) of the Sides of the two Bases, add the Sum of their Squares; that Sum being multiply'd into one Third of the Height of the *Frustrum*, will give its Solidity, if the Bases be square.

Or thus, which is the same in Effect:

Multiply the Areas of the two Bases together, and add the two Areas to the square Root; and that Sum multiply'd by one Third of the Height, gives the Solidity of any *Frustrum*, either square or multangled.

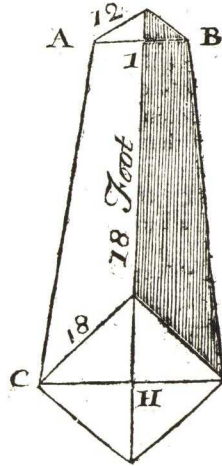
R U L E II.

Add one third Part of the Square of their Difference to the Rectangle of the Sides of two Bases; and that Sum being multiply'd into the Height, will, if the Bases be square, produce the Solidity: But if they be triangular, or multangular, the said Rectangle of the Sides, with the third Part of the Square of their Difference, will be the Square of a mean Side; and the square Root thereof will be such a mean Side, as will reduce the tapering Solid to a Prism equal to it.

Example. Let $ABCD$ be the *Frustrum* of a square Pyramid,

F R

the Side of the greater Base 18 Inches, and the Side of the lesser



12 Inches, and the Height 18 Feet; what is the Solidity of it?

First, Multiply the two Sides together 18 by 12, and the Product will be 216; and the Difference of the Sides is 6, the Square of which is 36, a third Part of which is 12; which being added to 216, the Sum is 228 Inches, the Area of a mean Base; which being multiplied by 18 Feet, the Length, the Product will be 4104: This being divided by 144, the Quotient will be 28.5 Feet, the Content.

Or, by the first Rule, thus:

The Square of 18 is 324, and the Square of 12 is 144, and the Rectangle of 18 by 12 is 216: The Sum of these three is 684, which multiply'd by 6, the Product will be 4104; which divided by 144, the Quotient will be 28.5 Feet, the same as before.

The

F R

F R

The Operation both Ways.

$$\begin{array}{r}
 \overbrace{18} \quad \overbrace{6} \text{ Diff.} \\
 \underline{12} \quad \underline{6} \\
 216 \quad 3)36 \text{ (Square.} \\
 \underline{12} \text{ Add. —} \\
 \underline{\quad} \quad 12 \text{ a Third.} \\
 228 \text{ the Sum.} \\
 18 \text{ the Height.} \\
 \hline
 1824 \\
 228 \\
 144)4104(28.5 \\
 \hline
 1224 \\
 720 \\
 \dots \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \overbrace{18} \quad \overbrace{12} \\
 \underline{18} \quad \underline{12} \\
 \hline
 \left. \begin{array}{l} 324 \text{ Sq.} \\ 144 \text{ Sq.} \end{array} \right\} \\
 216 \\
 \hline
 684 \text{ the Sum.} \\
 6 \text{ a Third of the Height.} \\
 \hline
 144)4104(28.5 \text{ Feet.} \\
 \hline
 1224 \\
 \hline
 720 \\
 \dots \\
 \hline
 \end{array}$$

By Feet and Inches thus :

$$\begin{array}{r}
 \begin{array}{c} F. \quad I. \quad I. \\ \text{Multiply } 1 : 6 : 6 \\ \text{by } 1 \quad \quad 6 \\ \hline \text{Product } 1 \quad 6 \quad 3)369 \\ \text{Add } 0 \quad 1 \\ \hline \end{array} \\
 \begin{array}{c} \text{Multiply } 1 : 7 \\ \text{by } 18 \quad 0 \text{ Height.} \\ \hline 18 : 0 \\ 9 \quad 0 \\ 1 \quad 6 \\ \hline \end{array} \\
 \text{Content } 28 : 6 \\
 \hline
 \end{array}$$

Or thus ;

$$\begin{array}{r}
 \begin{array}{c} F. \quad I. \\ 2 \quad 3 \text{ Square of the greater.} \\ 1 \quad 6 \text{ the Rectangle.} \\ 1 \quad 0 \text{ Square of the less.} \\ \hline 4 \quad 9 \text{ Trip of a mean Area.} \\ 6 \quad 0 \text{ a Third of the Height.} \\ \hline 28 : 6 \end{array}
 \end{array}$$

To find the superficial Content.

The Perimeter of the greater Base is 72, and the Perimeter of the lesser Base is 48 ; add both the Perimeters together, the Sum will be 120 ; the half of which is 60 ; which being multiplied by

18 Feet, the Product will be 1080 ; which being divided by 12, the Quotient is 90 Feet ; to which add the two Bases 2.25 Feet, and 1 Foot, the Sum will be 93.25 Feet, the whole superficial Content.

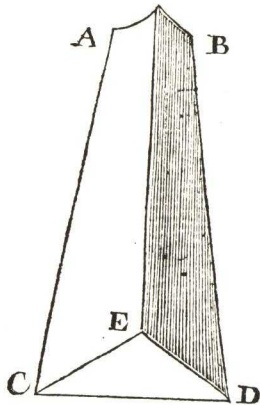
F R

$$\begin{array}{r}
 18 \\
 4 \\
 \hline
 72 \\
 48 \\
 \hline
 2)120 \\
 \hline
 60 \\
 \hline
 \end{array}
 \qquad
 \begin{array}{r}
 12 \\
 4 \\
 \hline
 48 \\
 \hline
 \end{array}$$

F R

$$\begin{array}{r}
 18 \text{ Height.} \\
 60 \\
 \hline
 12)1080(\\
 90 \text{ Feet.} \\
 2.25 \text{ the greater Base.} \\
 1 \text{ the lesser Base.} \\
 \hline
 93.25 \text{ Sum.} \\
 \hline
 \end{array}$$

Again, let A B C D be the *Frustrum* of a triangular Pyramid, each Side of the greater



Base 25 Inches, and each Side of the lesser Base 9 Inches, and the Length 15 Feet; what is the solid Content?

By the second Rule, multiply 25 by 9, and the Product will be 225; and the Difference be-

tween 25 and 9 is 16; which being squared, makes 256, a Part of which is 85.333; which being added to 225, the Sum is 310.333; and this being multiply'd by 433, the Product will be 134.374, 56. which is the Area of a mean Base; and that multiply'd by 15 Feet, the Length, the Product will be 2015.610; which being divided by 144, the Quotient will be 13.99 Feet, the Solidity.

Or thus, by the latter Part of the first Rule: Find the Area of the greater Base, which will be 270.625, and the Area of the lesser Base will be 35.073; these two Areas being multiply'd together, the Product will be 9491.639625, the square Root of which is 97.425; to which add the two Areas, and the Sum will be 403.123; which multiply'd by a third Part of the Length 5, the Product will be 2015.615; and that divided by 144, the Quotient is 13.99 Feet, as before.

See

F R

F R

See the Operation of both.

	<u>25</u> 9	<u>25</u> 9		<u>25</u> 25	<u>9</u> 9	<u>433</u> 81
Product	225	16	Diff.	125	81	Sq. 433
		<u>16</u>		<u>50</u>		<u>3464</u>
		96		625	Square.	35.073
		<u>16</u>		<u>433</u>		
		3)256 the Square.		1875		270.625
				1875		<u>35.073</u>
		85.333 a Third.		2500		
		225. Add.				811875
				<u>270.625</u> Area.		1894375
		310.333				1353125
		.433 tabular Number.				<u>811875</u>
						9491.630625
		930999				81 (97.0425
		<u>930999</u>				
		1241332				
					187)1391	
		134.374189 Mean Area.			<u>1309</u>	
		15 Length.				
					1944)8263	
		671.870945			<u>7776</u>	
		<u>1343.74189</u>				
					19482)48706	
		144)2015.612835 (13.99 Feet.			<u>38964</u>	
		575			194845)974225	
		<u>1436</u>			<u>974225</u>	
		1401				
						
		<u>105</u>				

270.625

F R

270.625 greater Area.
 97.425 the mean Proportional.
 35.073 the lesser Area.

403.123 the Triple of a mean Area.
 5 a third Part of the Height.

144) 2015.615 (13.99 Feet, the Solidity.

575
 1436
 1401

105

In finding the Area of the triangular Base, you multiply by .433, because that is the Area of the equilateral Triangle, when the Side of it is 1, according to the Table of the Areas or Multipliers for finding the Areas of Polygons. See the Article POLYGONS.

Multiply the Square of the Side by the tabular Number, and the Product will be the Area of the Polygon.

To find the superficial Content.

The Perimeter of the greater Base is 75, and the Perimeter of the lesser Base is 27; the Sum of both is 102, and the Half is 51; which being multiply'd by 15 Feet, the Product will be 765; which being divided by 12, the Quotient will be 63.75; to which add the Sum of the two Bases 2.12 Feet, and the Sum will be 65.87 Feet, the whole superficial Content.

Note, That 51 should have been multiplied by the slant Height; but the Difference it would make is but .06 of a Foot, which is inconsiderable.

F R

Frustum of a Cone, is that Part of a Cone which remains when the top End is cut off by a plain Parallel to the Base.

To find the solid Content of it, are the same, in effect, as for the Frustum of a Pyramid.

R U L E I.

To the Rectangle of the Diameters of the two Bases add the Squares of the said Diameters, and multiply the Sum by .7854, the Product will be the Triple of the mean Area; which multiplied by one Third of the perpendicular Height, that Product will be the solid Content.

Or thus :

Multiply the Area's of the greater and lesser Bases together, and out of the Product extract the square Root; then add the square Root and two Area's together, and multiply the Sum by one Third of the perpendicular Height, and the Product will be the solid Content.

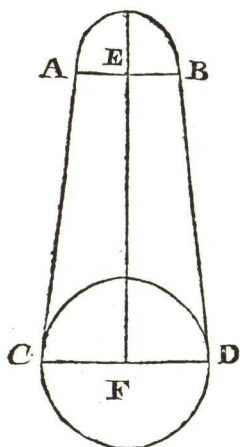
R U L E

F R

R U L E II.

To the Rectangle of the greater and lesser Diameters add $\frac{1}{3}$ Part of the Square of their Difference, and multiply the Sum by .7854, the Product will be a mean Area; which multiplied by the perpendicular Height, the Product will be the Solidity.

Example. Let ABCD be the *Frustum* of a *Cone*, whose greater Diameter CD is 18 In-



ches, and the lesser Diameter AB is 9 Inches, and the Length

F R

14.25 Feet, which is the solid Content.

Multiply 18 by 9, and the Product will be 162; and the Difference between 18 and 9 is 9, whose Square is 81, a third Part of which is 27; which add to 162, and the Sum will be 189; This being multiply'd by .7854, the Product will be 148.44; which being divided by 144, the Quotient will be 1.03 Feet, the Area of the mean Base; which multiply 14.25 Feet, the Height, the Product is 14.6775 Feet, the solid Content.

Or thus, by the first Rule.

The Square of 18 (the greater Diameter) is 324, and the Square of 9 (the lesser Diameter) is 81, and the Rectangle or Product of 18 by 9 is 162; the Sum of these three is 567, which multiply'd by .7854, the Product is 445.3218; which divided by 144, the Quotient is 3.09 Feet, the triple Area of a mean Base: This multiply'd by 4.75, a Third of the Height, the Product will be 14.6775 Feet, the Solidity the same as before.

See

F R

F R

See the Operation.

18	18 From	.7854
9	9 Subt.	189
162	9 Rem.	70686
Add 27	9	62832
Sum 189	3) 81 Square.	7854
	27 a Third.	144) 148.44 96 (1.03.
		144
		444
Height 14.25 Feet.		432
Area Base 1.03 Feet.		12
	4279	
	1425	

Solid Content 14.6775 Feet.

324 the Square of 18.
162 the Rectangle.
81 the Square of 9.

567 the triple Square of a mean Diameter.

.7854	3.09
567	4.75
54978	1545
74124	2163
39270	1236
144) 445.32 18	Solid. 14.6775
1332	
36	

which multiply'd by 14.25 Feet, and the Product is 604.36, &c. which divided by 12, the Quotient is 50.36 Feet, the Curve-Surface; to which add the Sum of the two Bases 2.21 Feet, the Sum is 52.57 Feet, the whole superficial Content.

To measure the *Frustum* of a rectangled Pyramid, called a *Prismoid*, whose Bases are parallel to one another, but disproportionate.

The RULE.

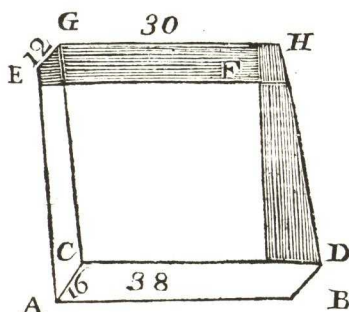
To find the superficial Content. You will find the Circumference of the greater Base to be 56.5488, and of the lesser Base 28.2744; the Sum of both is 84.8232, the half Sum is 42.4116;

To the greatest Length add half the lesser Length, and multiply

F R

tiplv the same by the Breadth of the greater Base, and reserve the Product.

Then to the lesser add half the greater Length, and multiply the Sum by the Breadth of the lesser Base; and add this Product to the other Product reserved, and multiply that Sum by a third Part of the Height, and the Product will be the solid Content.



Example. Let ABCDEFGH be a Prismoid given, the Length

$38 = AB.$	$30 = EF.$	
$15 = \frac{1}{2} EF.$	$19 = \frac{1}{2} AB.$	$144) 2872 (19.94 \text{ Feet, the Content.}$
		1432
53	49	
$16 = AC.$	$12 = EG.$	1360
		640
318	588	
53		64
848		
588		
1436		
$2 = \text{a third Part of the Height.}$		
2872		

F R

of the greater Base AB 38 Inches, and its Breadth AC 16 Inches; and the Length of the lesser Base EF is 30 Inches, and its Breadth 12 Inches, and the Height 6 Feet: What is the solid Content?

To the greater Length AB 38, add half the lesser Length EF 15, the Sum will be 35; which being multiply'd by 16, the greater Breadth, the Product will be 848; which reserve.

Again, to EF 30 add half AB 19, and the Sum will be 49; which multiply by 12, the lesser Breadth EG, and the Product will be 588: To which add 848, the reserv'd Product, and the Sum will be 1436; which being multiply'd by 2, a third Part of the Height, the Product will be 2872; this Product divide by 144, and the Quotient will be 19.94 Feet, the solid Content.

F R

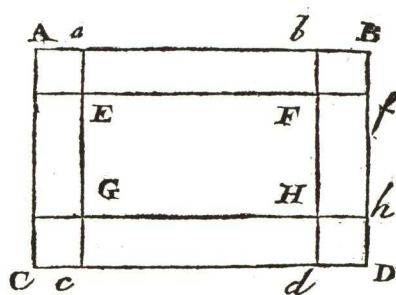
F R

To prove this Rule: Let it be supposed the Solid cut into Pieces, so as to make it capable of being measured by the foregoing Rules, thus: Let ABCD represent the greater Base, and EFGH the lesser Base; and let the Solid be supposed to be cut off through by the Lines *ac*, *bd*, and *ef*, *gh*, from the Top to the Bottom; so will there be a Parallelopipedon, having its Bases equal to the lesser Base EFGH, and its Height, 6 Feet, equal to the Height of the Solid: Multiply 30 (the Length of the Base) by 12 (the Breadth thereof) and the Product is 360; which multiply by the Height 6 Feet, and the Product is 2160.

Then there are two Wedge-

like Pieces, whose Bases are *ab*, EF, and GH, *cd*; if these two Pieces are laid together, the thick End of one to the thin End of the other, they will compose a rectangled Parallelopipedon; which, to measure, multiply the Length of the Base 30 by its Breadth 2, and the Product will be 60; which multiply by 6, the Height, the Product is 360.

Then there are two other Wedges like Pieces, whose Bases are *eE*, *gG*, and *fF*, *hH*; these two laid together, will compose a rectangled Parallelopipedon: To measure this, multiply the Length of the Base 12 by the Breadth 4, the Product is 48; which multiply by 6, the Height, the Product is 288.



And lastly, there are four rectangled Pyramids at each Corner; which, to measure, multiply the Length of one of the Bases 4 by its Breadth 2, the Product is 8; which multiply'd by 2, (a third Part of the Height,) the Product is 16; and that multi-

ply'd by 4, because there are four of them, the Product is 64; then add all these together, and the Sum is 2872; and divide by 144, the Quotient is 19.94 Feet, the same as before, which shews the Rule to be true.

See

See the Operation :

12	30	12	4
30	2	4	2
360	60	48	8
6	6	6	2
2160	360	288	16
360			4
288			
64			64

144) 2872 (19.94 Feet the whole Content.

To find the superficial Content.

Half the Perimeter of the greater Base is 54, and half the Perimeter of the lesser Base is 42; which being added together, the Sum is 96; which being multiply'd by 6 (the Height) the Product will be 576: Then divide this Product by 12, and the Quotient is 48 Feet; to which add the Sum of the two Bases 6 72 Feet, and the Sum will be 54.72 Feet, the whole superficial Content.

FUNNELS of Chimneys. The *Funnel* is the Shaft, or smallest Part from the Wattle, where 'tis gathered into its least Dimensions.

Palladio directs, That the *Funnels* of Chimneys be carried through the Roof, three, four, or five Feet at the least, that they may carry the Smoke clear from the House into the Air.

He advises also, that Care be taken as to the Width of them; for that if they be too wide, the Wind will drive back the Smoke into the Room; and if

they be too narrow, the Smoke will not be able to make its Way.

Therefore Chamber Chimneys must not be made narrower than ten or eleven Inches, nor broader than fifteen; which is the ordinary Depth of the *Funnels* of great Kitchen Chimneys, whose Breadth is four or five Feet within the Work, from the Place where the Breast ends, to the Top of the *Funnel*.

Now the said Breast reaches from the Mantle-Tree to the Ceiling or Pitch of the Arch, always diminishing within the Work, till you come to the Measures of Depth and Breadth before mentioned; and from thence to the End of the *Funnel*, it must be carried up as even as it possibly can be; for if there be a Failure in this, the Smoke happens to be offensive.

FURRING, in Architecture, is the making good the Rafters Feet in the Cornice.

Thus, when Rafters are cut with a Knee, these *Furrings* are Pieces which go straight along with the Rafter, from the Top of the Knee to the Cornice.

F U

Also when Rafters are rotten, or sunk hollow in the Middle, there are Pieces cut thickest in the Middle, and tapering towards each End, which are nailed upon them, to make them straight. Such Pieces are called *Furs*, and the Putting them on, *Furring the Rafters*.

FUSAROLE, in Architecture, is a Moulding or Ornament placed immediately under the Echinus in the *Doric*, *Ionic*, and *Composite* Capitals.

The *Fusarole* is a round Member carv'd in Manner of a Collar or Chaplet with oval Beads. The *Fusarole* should always answer exactly under the Eye of the Volute, in the *Ionic* Capital.

FUST, in Architecture, is the Shaft of a Column, or that Part comprehended between the Base and the Capital. Also called the *Naked*.

The *Fust* is that cylindrical Part which makes, as it were, the Body or Trunk of the Column, exclusive of the Head and Feet.

The Word is *French*, and literally signifies a *Cask*. But some derive it from the *Latin* *Fustis*, a *Club*.

G A

GABLE-END of a *House*, is the upright triangular End from the Cornice or *Eaves*, to the Top of its Roof.

G A

To measure a Gable-End.

Multiply the Breadth at Bottom by half of the Perpendicular, or Line from the Angle of the Top to the Middle of the Bottom, or multiply half the former by the whole of the latter, and the Product will give the Content in such Measures as the Dimensions were taken in.

GAIN, the Beveling Shoulder of the Joists, or other Stuff.

'Tis also used for the lapping of the End of the Joists, &c. upon a Trimmer or Girder; and then the Thickness of the Shoulder is cut into the Trimmer, also bevelling upwards, that it may just receive the *Gain*, and so the Joist and Trimmer lie even and level with their Surface.

This Way of working is used in Floors and Hearths.

GALLERY, in Architecture, is a covered Place in a House, much longer than broad, and which is usually on the Wings of a Building, serving to walk in.

Gallery is also a little Isle or Walk, serving as a common Passage to several Rooms, placed in a Line or Row.

Their Length (according to *Palladio*) ought to be at least five Times their Breadth. They maybe six, seven, or eight Times their Breadth, but must not exceed.

GARD MANGER, a Storehouse or Room to set Meat in.

GATE,

GATE, a large Door leading or giving Entrance into a City, Town, Castle, Palace, or other considerable Building; or a Place for Passage of Persons, or Horses, Coaches, or Waggon, &c.

As to their Proportion: The principal *Gates* for Entrance, through which Coaches and Waggon are to pass, ought never to be less than seven Foot in Breadth, nor more than twelve Foot; which last Dimension is fit for large Buildings.

As to the Height of a *Gate*, it ought to be one and a half of the Breadth and something more.

But as for common *Gates* in Inns, under which Waggon go loaded with Hay and Straw, &c. the Height of them may betwix their Breadth.

Of the Price of some Sorts of Gates.

As to the Price of *Gates*, it is various, according to the Sorts of *Gates*; which again will differ according to the Dimensions and Workmanship. I shall at present mention only *Pallisadoe* and *Pold-Gates*.

Of Pallisadoe Gates.

Mr. *Wing* says, in *Rutlandshire*, if the *Gates* be six or seven Feet high, and the Workman find Timber and Workmanship, they are worth about 9 or 10*s.* per lineal Yard; but if he find only Workmanship, then it is worth but 6 or 7*s.* per Yard.

If they are *Semi-Pallisadoe*, with kneeling Rails at the Top, handsomely moulded on both Sides, and square Pallisadoes,

raised Pannels, and Bisection-Mouldings on both Sides, the *Gates* about eight Feet high, and the Posts a Foot square, opened in the Front, or revailed with a Moulding struck in it on both Sides the Revail, a Base and Capital laid on the Posts, and the Heads cut into one of the *Plattonick* Bodies; as, suppose an *Icosaedron*, and the Posts were about ten or eleven Feet above Ground, then the Workmanship is worth 12 or 13*s.* a Yard lineal; but if the Workmen find Timber, it will be worth upwards of 20*s.* a Yard lineal; in such *Gates*, to find all Iron-Work, Painting, &c. it would be worth above 30*s.* a Yard lineal.

Of Pold Gates.

These are such as are set up in Fences, for shutting up the Passages into Fields, and other Inclosures.

These are of two Sorts, either of sawed, or cleft Timber. For the making one of sawn Timber, setting it up, and its Posts, the Price in different Places, is from 3*s.* 6*d.* to 5*s.* But if the Carpenter pay for the Sawing, then the Price is from 5*s.* to 6*s.* 6*d.* Such a *Gate*, Timber and Work, is worth from 7*s.* to 10*s.* according to the Goodness; but with Posts, from 12*s.* to 15*s.* but *Gate* and Iron-Work, from 10*s.* to 13*s.* and Posts from 15*s.* to 18*s.*

Cleft Pold-Gates, Cleaving, Making, and Hanging, from 4*s.* to 5*s.* and so proportionably for all Timber, Iron, and Posts. The Reason why the Prices are different,

rent, is, because they are according to the Customs of different Places.

GAVEL is used for what is more usually call the *Gable*.

GENERATED? in Mathematics
GENITED Sticks, is us'd to signify whatever is produced either in Arithmetick, by the Multiplication, Division, or Extraction of Roots; or in Geometry, by the finding out the Contents, Areas, and Sides, or of extream and mean Proportionals, without Arithmetical Addition, and Subtraction.

GENERATING LINE, or *Figure*, in Geometry, is that which, by its Motion or Revolution, produces any other Figure, plane, or solid: Thus a Right Line, mov'd any way parallel to itself, *generates* a Parallelogram; round a Point, in the same Plane, with one End fasten'd in that Point, it *generates* a Circle; one entire Revolution of a Circle in the same Plane, *generates* the Cycloid; the Revolution of a Semicircle round its Diameter, *generates* a Sphere, &c.

GENESIS, in Geometry, is the Formation of any Plane or solid Figure by the Motion of some Line or Surface; which Line or Surface is always call'd the *Describent*; and that Line, according to which the Motion is made, is called the *Dirigent*.

GEOCENTRICK is apply'd to any Thing which has the Earth for its Centre.

GEODÆSIA, Surveying, or the Art of measuring Land.

GEODETICAL Numbers, are such Numbers as are considered according to those vulgar

names or Denominations, by which Money, Weights, Measures, &c. are generally known, or particularly divided by the Laws and Customs of several Nations.

GEOGRAPHY is the Science that teaches and explains the Properties of the Earth, and the Parts thereof that depend upon Quantity.

GEOMETRICAL, of or pertaining to Geometry.

Geometrical Plane. See PLANE.

Geometrical Place. See LOCUS.

Geometrical Solution of a Problem, is when the Thing is solved according to the Rules of Geometry, and by such Lines as are truly *Geometrical*, and agreeable to the Nature of the Problem.

GEOMETRY originally signify'd the Art of Measuring the Earth; but it is now the Science of whatever is extended, so far as it is, such, that is of Lines, Superficies, and Solids.

It is very probable, that Geometry had it first Rise in *Egypt*, where the Nile annually overflowing the Country, and covering it with Mud, obliged Men to distinguish their Lands one from another, by the Consideration of their Figure; and to be able also to measure the Quantity of it, and to know how to plot it, and to lay it out again in its just Dimensions, Figure, and Proportion. After which, 'tis likely, a farther Contemplation of those Draughts and Figures, help them to discover many excellent and wonderful Properties belonging to them; which Speculation

cultation continually was improving, and is still to this very Day.

But the *Geometry* of the Antients was contained within very narrow Bounds, in Comparison of the Modern, as well as their other Mathematical Speculations; for it only extended to Right Lines and Curves of the first Kind or Order: Whereas new Lines of infinite Orders, are received into the Modern *Geometry*; which Orders are defin'd by Equations, involving the Ordinates and Abscisses of Curves.

Sir *Isaac Newton* was the first Person who gave any tolerable Account of the Nature of Curves above Conick Sections.

Geometry is divided into Speculative, and Practical: The former treats of the Properties of Lines and Figures, such as *Euclid's Elements*, and *Apollo-nius's Conicks*: And the latter shews how to apply these Speculations to Use in Life.

GILDING *with Gold or Silver.* Whatsoever you would *gild*, must be first drawn with Gold Size, according to the true Proportion of what you would have *gilt*, whether Figure, Letter, or whatever it be.

When the Gold Size has been thus laid on, it must stand till it is dry enough to *gild*, which is to be known by touching it with the End of your Finger; for if your Finger stick a little to it, and yet the Gold Size come not off, then it is dry enough; but if the Colour come off on your Finger, then it is not dry enough, and must be let alone a little longer; for if you should

then lay your Gold on, it would so-drown it, that it would have no Lustre: But on the other Hand, if your Size should be so dry, as not, as it were, to adhere a little to your Finger, then it is too dry, and the Gold will not take, for which there is no Remedy but new Sizing: Therefore you must watch the very Nick of Time, when it is neither too wet nor too dry, both Extreame being unfit for laying the Gold on it.

When your Size is ready for *Gilding* take your Book of Leaf-Gold, and open a Leaf of it; take it out with your Cane Plyers, and lay it on your *Gilding Cushion*; and if it lie not smooth, blow on it with your Breath, but very gently, which will make it lie flat and plane; then with a Knife of Cane, or for want of that a common Pocket-Knife, (that hath a smooth and sharp Edge, being wiped very dry on your Sleeve, that the Gold stick not to it,) cut your Leaf-Gold into such Pieces or Forms as you judge most suitable to your Work.

When you have thus cut a Leaf of Gold into proper Forms, then take your *Gilding Pallet*, and breathe upon it to make it dampish, that the Gold may stick to it: With this Tool take your Gold up, (by clapping it down on the several Pieces you had before cut into Forms,) and transfer it to your Size, upon which clap it down as dextrously as you can, and the Gold will leave the Pallet, and stick on the Size; which you must afterwards press down smooth with

a Bunch of Cotton, or the Bottom of a Hare's Foot; and thus you must do Piece by Piece, till you have covered all your Size with Gold; and after it is fully dry'd, then with your Hare's Foot brush off all the loose Gold, and the *Gilding* will remain fair and beautiful.

If the Work to be *gilded* be very large, open your Book of Leaf-Gold, and lay the Leaf down on your Work without cutting it to Pieces, and so do Leaf by Leaf, till you have covered quite over what you intend to *gild*: And if some particular Places do miss, take up with a small Bunch of Cotton a Piece of Leaf-Gold cut to a fit Size, and clap it on, that the Work may be intirely covered: And if the Gold be to be laid in the Hollows of carv'd Work, you must take it up on the Point of a Camel's Hair Pencil, and convey it in, and with the said Pencil dab it down till it lie close and smooth.

Note, That after your *Gilding* is thus finished, you may, if you please, diaper or flourish on it with thin burnt Umber, whatsoever shall be suitable to your Design. The Umber must be tempered but thin, so that the Gold may appear through it.

Note further, That a Book of Gold contains 24 Leaves, each Leaf being three Inches square, the Price of each Book is two Shillings at the Gold-Beaters; one Book will cover 216 square Inches of Work, for so many square Inches are con-

tained in 24 Leaves that are three Inches square, every Leaf containing nine square Inches superficial in Gold. By this you may know how many Books of Gold will serve to *gild* a Work, whose superficial Content in square Inches may before be known.

Gilding with Silver: In laying on Silver upon an oily Size, the same Methods in all Respects is required as for *gilding* with Gold, save only in this, that the Size upon which Silver is laid, ought to be compounded of a very little yellow Oker, and much White Lead; for the Size being of a light Colour, the Silver laid on it will look more natural, and retain its own Colour better the whiter the Size is.

Note. That the common Painters do now generally, in *gilding*, use more Silver than Gold, in most Works that are not much exposed to the Air, to which they afterwards give the Colour of Gold, by means of the Lacker Varnish; the Use of which is now so common, that if they *gild* any Thing that stands free from the Weather, they only *gild* with Silver, and so give it the Colour of Gold with Lacker Varnish, made with Gum-Lake dissolved in Spirits of Wine, and laid over it.

A *Gilding Cushion*, an Utensil generally made of a smooth-grain'd Basil Skin, the Flesh Side outwards; this is to be nail'd to the Edges of a square wood-square,

den Bottom about six Inches square, and then well stuffed out with Cotton or Wooll very hard, plain, and flattish: Upon this *Gilding Cushion* the Gold Leaves are to be laid when you would cut them into such Scantlings as will best fit the Work you design to *gild*.

Gilding Knife, a Slip of the hollow *Spanish Cane*, cut up to a smooth and sharp Edge with a good Penknife. This Cane Knife is accounted the best, because, if well made, it will not only be very sharp, but also cut the Gold Leaf more naturally than any other; for a Steel Knife, though it cut very well, yet the Gold will stick to it, and so give you much Trouble to part the Leaf from it, except you are careful to keep the Edge very dry, by continually wiping it with a clean dry Cloth.

Gilding Pallet, is a flat Piece of Wood, about three Inches long, and an Inch broad, upon which is to be glued a Piece of fine

Woollen Cloth, of the same Length and Breadth. Upon this Pallat do but breath with your Breath, that the Cloth may be made a little moist by it, and then if you clap it down gently upon the Gold that is cut out on the Cushion, it will stick to the Pallat, and may thence be conveyed to the Work you are to *gild* and lay down on it.

GIRDING BEAMS, are used by some Architects for the same as Girders.

GIRDERS, in Architecture, are some of the largest Pieces of Timber in a Floor, the Ends of which are usually fastened into Summers and Brest-Summers; and Joists are framed in at one End to the *Girders*.

The Scantlings and Size of *Girders* and Summers, upon the Rebuilding of *London*, after a Consultation of experienced Workmen, were reduced into an Act by the Parliament, and are thus set down, as fit for all Fa- bricks, great and small.

	Feet.		Feet.		Feet.		Feet.		Feet.
<i>Girders and Summers, must be in Length</i>	$\left. \begin{array}{l} 10 \\ 15 \\ 18 \\ 21 \\ 24 \end{array} \right\}$	to	$\left. \begin{array}{l} 15 \\ 18 \\ 21 \\ 24 \\ 26 \end{array} \right\}$	and in Breadth	$\left. \begin{array}{l} 11 \\ 13 \\ 14 \\ 16 \\ 17 \end{array} \right\}$	in	Depth	$\left. \begin{array}{l} 8 \\ 9 \\ 10 \\ 12 \\ 14 \end{array} \right\}$	

How they are to be laid in the Brickwork.

No *Girder* or *Summer* ought to be less than ten Inches into the Wall, and their Ends must be laid in Loam.

That *Girders* and *Summer* be

of good hearty Oak, as free from Knots as may be; because that will be the least subject to break, and may with more Safety be relied on in this cross and transverse Work.

In as much as there is a Moisture in Timber, a certain ingenious modern Builder advises,
D d 4 that

that all bearing Timber have allow'd it a moderate Camber or Roundness; for till that Moisture is in some sort dry'd out, the said Timber will sag with its own Weight; and that chiefly is the Reason why *Girders* are truss'd.

But here you must observe, that *Girders* are best truss'd when they are first sawn out; for by its drying or sinking, it lightens the Trusses in them yet more.

It is also to be observ'd, that all Beams or Ties be cut or forced in framing to a Camber or Roundness, such as an Inch in the Length of eighteen Feet; and that principal Rafter be also cut, or forced up to a Camber or Roundness, as before. The Reason of this is, all Trusses, though ever so well fram'd, by the Shrinking of the Timber, and Weight of the Covering, will sag, and sometimes so much, as to offend the Eye of the Beholder: So that by this Preparation, your Truss may ever appear well.

You should also observe, that all Case Bays, either in Floors or Roofs, do not exceed twelve Feet, if possible; that is, do not let your Joists in Floors, your Purlins in Roofs, &c. exceed twelve Feet in their Length or Bearing, but rather let their Bearing be eight, nine, or ten Feet.

Also in Bridging-Floors, do not place your binding or strong Joists above four or five Feet apart; nor let your Bridgings or common Joists be above twelve Inches apart, that is, between one Joist and another.

It should also be observ'd never to make double Tenants or

Tenons for bearing Uses, such as Binding Joists, common Joists or Purlins; for in the first Place, it weakens very much whatever you frame it into; and, in the second Place, it is a Rarity to have a Draught in both Tenons, that is, to draw your Joint close by the Pin; for the said Pin, by passing through both Tenons, if there is a Draught in each, must bend it so much, that except the Pin be as tough as Wire, it must needs break in driving, and consequently do more Hurt than Good.

GIRT. See FILLET.

GIVEN is a Word often used in the Mathematicks, and signifies something which is suppos'd to be known.

Thus if a Maguitude be known, or we can find another equal to it, we say, it is a *Given Magnitude*, or that such a Thing is *given* in Magnitude.

If the Position of any Thing be suppos'd as known, then say, *Given in Position*.

Thus if a Circle be actually described upon any Plane, they say, its Centre is *given in Position*; its Circumference is *given in Magnitude*, and the Circles is *given both in Position and Magnitude*.

But a Circle may be *given in Magnitude* only; as when only its Diameter is *given*, and the Circle not actually described.

If the Kind or Species of any Figure be *given*, they say, *Given in Specie*; if the Ratio between any two Quantities, is known, they are said to be *given in Proportion*.

GLACIS, in Building, &c. is an easy insensible Slope or Declivity.

GLASS,

GLASS, a Diaphanous or Transparent Body, made by Art, of Sand and Nitre, as *Pliny* says. It is also made of white glistering Flints mixed with *Salt Alkali*, or the Salt of the Herb Glaswort, or Salt of Fern-Ashes, for common *Glass*, some say.

M. *Blancourt* says, the *Venetians* use white Flints, and also a rich Sand, and likewise a sort of white Marble. He likewise adds, that all white transparent Stones, which will not burn to Lime, are fit to make; and that all Stones that are fit to strike fire, are capable to be made into *Glasses*.

A certain learned and curious Author gives us the following Characters or Properties of *Glass*, whereby it is distinguish'd from all other Bodies, *viz.*

1. That it is an artificial Concrete of Salt, Sand, or Stones.

2. That it is *fusible* by a strong Fire.

3. That when fused, it is tenacious and coherent.

4. That it does not waste or consume in the Fire.

5. That when melted, it cleaves to Iron.

6. That when it is red-hot, it is ductile, and capable of being fashion'd into any Form, but not malleable; and capable of being blown into a Hollownet, which no Mineral is.

7. That it is frangible when thin, without annealing.

8. That it is friable when cold.

9. That it is always Diaphanous, whether hot or cold.

10. That it is flexible and elastick.

11. That it is dissoluble by Cold and Moisture.

12. That it is only capable of being graven or cut with a Diamond and Emery.

13. That it receives any Colour or Dye, both externally and internally.

14. That it is not dissoluble by Aqua Fortis, Aqua Regia, or Mercury.

15. Neither acid Juices, nor any other Matter, extract either Colour or Taste, nor any other Quality from it.

16. It admits of Polishing.

17. That it neither loses of Weight nor Substance, by the longest and most frequent Use.

18. That it gives Fusion to other Metals, and softens them.

19. That it is the most pliable Thing in the World; and that it best retains the Fashion given it.

20. That it is not capable of being calcin'd.

21. That an open *Glass* filled with Water in the Summer-Time will gather Drops of Water on the Outside, so far as the Water on the Inside reaches; and a Man's Breath blown upon it will manifestly moisten it.

22. Little *Glass Balls*, filled with Water, Mercury, or other Liquor, and thrown into the Fire; as also Drops of green *Glass* broken, fly asunder with a loud Noise.

23. That neither Wine, Beer, nor any other Liquor, will make it musty, or change its Colour, nor rust it.

24. That it may be cemented, as Stones and Metals.

25. That a *Drinking-Glass* partly filled with Water, and rubbed on the Brim with a wet Finger,

Finger, yields musical Notes, higher, or lower, as the *Glass* is more or less full, and makes the Liquor frisk and leap.

The Sorts of Glass.

There are various Sorts of *Glass*, which are made use of in the World; but at present, I shall only speak of those Sorts of *Glass* which Glaziers commonly use here in *England*; which are these following, viz. *Crown Glass*, which is of two Sorts; 1. *Lambeth* and *Ratcliff*. 2. *French* or *Normandy Glass*. 3. *German Glass* of two Sorts, White, and Green. 4. *Dutch Glass*. 5. *Newcastle Glass*. 6. *Staffordshire Glass*. 7. *Bristol Glass*. 8. *Looking Glass*. 9. *Jealous Glass*. Of which Sorts, I shall treat succinctly in their Order.

Crown Glass is of two Sorts, *Ratcliff* and *Lambeth Crown Glass*.

That Sort of *Crown Glass* that goes by the Name of *Ratcliff Crown Glass*, is the best and clearest Sort of *Crown Glass*; which Sort was at first made at the *Bear-Garden*, on the Bank-side, in *Southwark*, in the Year 1691. which was published in the *Gazette*, and commended, as follows, and called *Crown Window-Glass*, much exceeding *French Glass* in all its Qualifications.

But the Maker of this Sort of *Crown Glass* being now removed to *Ratcliff*, it therefore now bears the Name of *Ratcliff Crown Glass*, as it did at first of the *Bear-Garden Crown Glass*.

This Sort of *Crown Glass* is of a light Sky-blue Colour, which

may be very distinctly seen if it be laid on a Piece of a white Paper.

It has been reported, that an *English Glass-Maker* went over to *France* on Purpose to learn the *French Way* of making *Glass*; which he having attained to, came over again into *England*, and set up Making of *Crown Glass*, and in the Performance, outstripp'd the *French* his Teachers, as *Englishmen* usually do.

There are twenty-four Tables of this *Glass* to the Case, the Tables being of a circular Form about three Foot, six, seven or eight Inches in Diameter, and consequently each Table will be in Area about nine or ten Feet, and the Case betwixt two hundred and twenty, and two hundred and forty.

This *Glass* is brought from *Ratcliff* in such kind of Frames as *Newcastle Glass* is brought up to Town in, only the *Newcastle Glass* is brought on Shipboard; and this *Ratcliff Glass* upon Staves by two Men.

1. This *Glass* called *Ratcliff Crown Glass*, has been sold for about 9d. a Foot in *London*, cut into Squares, and when wrought in Lead, and set up, for about 18d. a Foot.

2. *Lambeth Crown Glass* takes its Name also from the Place where it is made. It is of a darker Colour than *Ratcliff Crown Glass*, and more inclining to the Green.

This Sort is sold for 8d. a Foot cut into Squares; and being wrought and set up into Windows with Lead, its Price is said to be worth about 16d. a Foot.

French

French Glass, also called *Normandy Glass*, because it was formerly made at *Cherbourg* in *Normandy*; and also *Lorrain Glass*, because made there. Now it is made wholly in the Nine Glass Works; five whereof are in the Forest of *Lions*; four in the County of *Eu*; the least at *Beaumont*, near *Rouen*. They also make *Glass* at *Nevers* in *Orleans*, and likewise at *St. Gobin*, near *La Fere* in *Picardy*; but from which of these Places, any *French Glass* comes, that is used in *England*, is uncertain.

It is a thinner and more transparent *Glass* than our *Newcastle Glass*, and when laid on a Piece of white Paper, it appears of a dirtyish green Colour.

It used to be of a middle Price, betwixt *Crown* and *Newcastle Glass*, which has been sold for 12 . a Foot, wrought in Lead, and set up.

Of this *Glass*, there is but twenty-five Tables to the Case.

German Glass. Of this there are two Sorts, White and Green.

The *White German Glass* is of a whitish Colour, and free from those Spots and Blemishes which our *Newcastle Glass* is subject to; but it has commonly some fine or small carved Lines or Streak'd Lines, as the *Newcastle Glass* hath.

Green German Glass. This, besides its greenish Colour, is subject to have those fine Lines or Streaks which the White is; but both the *Green* and the *White German* are straighter, and not so warp'd as the *Newcastle Glass* is. Both these Sorts of *Glass* are brought over from *Germany*, and yet is generally as cheap as *Newcastle Glass*.

Dutch Glass does not differ much from *Newcastle Glass* in its Colour and Price. 'Tis frequently much warp'd like that, and the Tables are but small.

Newcastle Glass, is that which is mostly used in *England*. 'Tis of an Ash Colour, and subject to Specks, Streaks, and other Blemishes, and besides, is frequently warp'd and crooked.

Mr. *Leybourn* says there are forty-five Tables to the Case, each Table containing five superficial Feet; and consequently a Case of forty-five Tables to the Case will contain two hundred and twenty-five Feet; tho' some say, there are but thirty-five Tables, and six Feet in each Table; which amount but to two hundred and ten Feet.

Mr. *Leybourn* says, that a Case of forty-five Tables, five Feet to a Table, equal to two hundred and twenty-five Feet, weighs about two hundred Weight, and consequently nine Feet will weigh about eight Pound.

As to the Price of *Newcastle Glass*, it is uncertain: For when Coals are plenty, then *Glass* is cheap; and when Coals are dear at *London*, then *Newcastle Glass* is so likewise; not that they want Coals at *Newcastle*, but because they have no other Conveyance for it to *London*: So that at some Times it has been at 30s. a Case, and at other Times 40s. But some say, that the most common Price is 34 s. the Case.

Some say, 'tis worth 6 or 7s. to cut a Case of this *Glass* into Quarries Diamond Fashion (with Halfs, and Quarters, and Three Quarters of Quarries, as the *Glass* falls out;) and others again have
said

said they would do it for half the Money.

Newcastle Glass, cut into large Squares, are sold from 22 s. to 25 s. per hundred Feet, according to their Size; and small Squares from 19 s. to 22 s. per hundred Feet; and Quarries of *Newcastle Glass* for about 16 s. per hundred Feet.

Glazing done with this *Newcastle Glass*, with Quarries, Banding, Soldering, and Pinning the Casements, being included, the usual Price in *London* is 5 d. or 6 d. per Foot. But in several Parts of the Country, they have 6 d. per Foot, and will be paid for pinning the Casements beside.

Glazing, in some Places of *England*, as in *Rutland*, and other Parts towards the North, is done with Quarries of *Newcastle Glass* at 4 d. $\frac{1}{2}$ or 5 d. per Foot; and Squares wrought into Lead, and set up, for 6 d. per Foot.

But in *Suffex*, *Kent*, and the South Parts of *England*, they will not work so cheap; because the *Glass* costs them something dearer. They usually reckon 7 d. per Foot for Glazing with Squares of *Newcastle Glass*, and they will be paid for pinning the Casements besides.

Staffordshire Glass, is a sort of *Glass* that is seldom used but in that and the neighbouring Counties.

Bristol Glass is so called, because it is made at the City of *Bristol*; but very little of it comes to *London*, by reason they have not the Convenience of sending it by Sea, as they have from *Newcastle* by Coal Ships; though this is as cheap, and better than *Newcastle Glass*.

Looking Glass. As to *Looking Glass* Plates, they are made either at the *Old Bear-Garden* in *Southwark*, or at *Vaux-Hall*, near *Lambeth*.

I am not certain, whether this Sort of *Glass* be not made with the Sort of Sand which Dr. *Grew* mentions in his *Museum Regalis Societatis*, p. 346.

Fine Sand, says he, from a Sand-Pit near *Bromley* in *Kent*, of which is made the clearest and best *English Glass*: It consists of some Grains as clear as *Chrystal*; which being mixed with others obscure, give a whitish Ash-Colour to the whole Mass.

Some have a Way of examining which is the whitest and clearest *Glass*; which is as follows:

They take it up close by one Edge, betwixt the Edges of the Middle and Forefinger; and then looking against the cut or broken Edge, the Eyes being thus skreen'd by the Edges of the two Fingers, they say, 'tis easy by this Method to discern which is the whitest and clearest *Glass*.

These *Looking Glass* Plates are ground smooth and flat, and polish'd. They are sometimes used in Sashes, or Sash-Windows. But 'tis a dear sort of *Glass*; for they ask 4 s. a Foot for such Squares, and if they are large, 'tis much more.

Looking Glasses, being foil'd, being in Vogue for Ornaments over Chimneys in Parlours, &c. I shall say something briefly concerning them.

Sir *William Petty* tells us, that the Value of *Looking Glass* Plates consists in a duplicate Proportion

portion of their Sides to their Squares.

Because you may not be left quite in the Dark as to this Matter, I shall give you the Price which I have known set down upon two Sizes of *Looking Glasses*, viz. one of five Feet long, and twelve Inches broad, in a Frame, to place over a Chimney, 40*s.* some of ten and eight Inches, in Walnut-Tree Frames, 4*l.* apiece, if they have the Diamond Cut; but if not, this Size is about 6*s.* apiece cheaper.

Jealous Glass is a sort of wrinkled *Glass*, of such a Quality, that what is done on the other Side of it cannot be distinctly seen; but yet it admits the Light to pass through it.

It is made of the same Materials that *Looking Glass* Plates are. It is cast in a Mould, and is composed all over its Surface with a Multitude of oblong circular Figures, (which are concave,) somewhat resembling Weavers Shuttles on the one Side; but the other consists of Figures a little convex; and this last Side is the Side they cut it on, when the Squares are too big for the present Use. It being very difficult to cut it on the concave Side.

Some Sorts of this *Jealous Glass* have a Convexity rising in the middle of the Concavity; so that one Side or Surface of it doth much resemble the Boats made by Boys by folding of Paper, only in this *Glass*, the Concavities and Convexities are more obtuse and blunt.

But there are various Sorts of

this *Glass*, in respect either to the Form or Size of the Figures of which this *Glass* is composed: Some of it having Shuttle-like Figures much larger than others; and some of it with the Points of Shuttles (as it were) very curved; and sometimes these Figures are in a perpendicular Position to one Edge of the Square, and other some are oblique to it.

This *Glass* is usually sold at about 18*d.* per Square, each Square being about twelve or fourteen Inches broad, and fifteen or sixteen Inches long.

The Reason why these Plates are so dear, is said to be, because the *Looking Glass Plate Makers* don't care to make them 'till their Pots of Metal are almost out, and that they are most at Leisure; for they say it wastes the Metal too much for their Profit.

This Sort of *Glass* is commonly used in and about London, to put into the lower Lights of Sash-Windows, &c. where the Windows are low next the Streets, to hinder People who pass by from seeing what is done in the Room: It is also sometimes set in Lead for the same Purpose.

This Sort of *Glass* must needs prevent People's seeing through it; because the Rays or Species of a visible Object, are by Reason of such a Variety of Refractions, (caused by the Inequality of the Surface of the *Glass*,) broken and confused, when they arrive at the Retina or Fund of the Eye.

*The Method of Working or
Blowing of WINDOW or TABLE
GLASS.*

The Method of making *Crown Window Glass*, as now practised in *England*, as has been before hinted, was borrow'd from the *French*, by an *English Glass Maker*, who went over to work in *France*, on purpose to penetrate into the Secret; which when he had attained to, he came back, and set up a *Glass Work*, wherein he far excelled the *French*, who were his Teachers.

This *Glass* is blown much after the Manner of *Looking Glass*, as follows:

The Furnace, Melting-Pots, Materials and Fire, are the same for *Window or Table Glass*, as for *Round Glass*; and the Difference in the Operation only commences after the Operator has dipped his Blowing-Iron a fourth Time in the melted Metal.

The *Glass* then being in this State, they blow it; but instead of rounding or forming it into a Punch, the particular Motion the Workman gives it in the directing and managing the Wind, and the Way of rolling it on the Iron, make it extend in Length two or three Feet, and form a Cylinder; which at first, is but two Inches in Diameter; but which, by being again committed to the Fire, and taken out, and blown afresh, becomes of the Extent requir'd for the Table of *Glass* to be formed; but with this Circumstance, that the Side which is fastened to the Iron, goes gradually diminishing, and ends in a kind of Cone or Pyramid.

In order to render the two Ends nearly of the same Diameter, after adding a little *Glass* to that opposite to the Iron, they draw it out with a Pair of Iron Pincers: After which, they cut off the same End with a little Water, and carrying the Cylinder back to the *Bocca*, they likewise incide or cut it with Water in two other Places, one, eight or ten Inches from the Iron, and the other the whole Length.

The *Glass Cylinder* being thus abridged of both its Extremities, is next heated on a kind of Earthen Table somewhat raised in the Middle, in order to promote its Opening at the Place incided or cut longitudinally or lengthways.

The Workman here makes use of an Iron, with which he alternately lowers and raises the two Sides or Halves of the Cylinder, which now begin to open and unfold like a Sheet of Paper, and at length grow perfectly flat.

The Table of *Glass* is now in its last Perfection, and needs nothing farther but to be heated over again.

They take it out, and lay it on a Table of Copper, from whence, after it has cool'd, and come to its Consistence, they carry it on Forks, to the Tower of the Furnace, where it is left for twenty-four Hours to anneal.

The Number of Tables annealed at a Time, which sometimes amount to a hundred, with the perpendicular Situation they are set in, occasion'd, antiently, that those which were first set in, sustaining in some measure the Pressure of all the last, were bent;

bent, and thus rendred inconvenient for Use.

But this Inconvenience has been since remedied, by separating them into Tens with an Iron Shiver; which diminishing the Weight by dividing it, keeps the Tables as flat and even as they were put in.

Glazier's Work, or Glazing.

Glazing is a manual Art, whereby the Pieces of Glass (by the Means of Lead) are so fitted and compacted together by *straight* or *curved* Lines, that it serves as well for the intended Use, (in a manner,) as if it were one entire Piece; nay, in some Respects, far better and cheaper, viz. in case of breaking, &c.

These two Heads of *Straight* or *Curved*, will admit of several Subdivisions. And,

First, of *Straight*; which contain a square Work, whose Angles are Right ones, as almost all Window-Lights are in Timber Window-Frames; and so likewise are the Squares, if *glaz'd* with such of which the Lights are composed.

Secondly, *Miter*, or such as make an Angle of 45 Degrees;

this but seldom happens in this Profession, unless it be in some Piece of Fret-Work.

Thirdly, *Bevel*: This is the most common, especially in the Country, and ordinary Houses, for most such are *glaz'd* with Quarries, which is Bevel-Work; so likewise is a great deal of Fret, and all Snip Work.

Curved Work consists either of Circles, Ovals, or some distorted Arches.

Circles and Ovals are commonly used for Lights at some particular Place in a Building, as in a Pediment over a Door, or the like, in the Middle of a Front, &c.

Of Glazier's Draughts.

The most ingenious *Glaziers*, both in the City and Country, work by Design, (and not by Guess,) they making a Draught of all their Windows on Paper, in which they set down the Dimensions of each Light, both of Height and Breadth; and the Number of Squares, both in Breadth and Height in each Light, and also the Number of Lights in each Window, after the following Manner.

1			2		
3	6	○	3	6	○
3	6	○	4	○	○
5			4	○	○
4			4	○	○
2	1	○	2	1	○
2	1	○	2	1	○
2	1	○	2	1	○
2	1	○	2	1	○
2	1	○	2	1	○
2	1	○	2	1	○

3		4		5		6	
4 50	4 50	4 50	4 50	4 25	3 75	3 75	
$\frac{4}{3}$	C	$\frac{4}{3}$	C	$\frac{2}{3}$	C	$\frac{5}{3}$	
1 50	1 50	1 50	1 50	12 5	1 75	1 25	

N. B. Here are six distinct Windows, *viz.* the two upper ones are three-light Windows; and of the four lower ones, there is one of three Lights, two single Lights, and one double one.

N. B. A Number standing at the Top (of the oblong Figure in the Scheme above) is the Height of the Light; that at the Bottom the Breadth, and that Number in the Middle the upper one for the Number of Squares in Height, and the lower one for the Number in Breadth.

N. B. also, That the first and second Windows (which are three-light Windows,) have their Dimensions set down in Feet, and duodecimal Parts of Feet; *e. g.* In the first Window you have this Number 3 6 0 at the Top, which signifies the Height of the Light to be 3 Feet and 6 duodecimal Parts of a Foot; in the Middle there is $\frac{4}{3}$, which signifies there is 6 Squares in Height and 4 in Breadth, (equal to 24 in the whole Light; and below there stands 2 1 0, which signifies 2 Feet, and one duodecimal Part of a Foot. In the second or middle Light,

there is a C, set to shew that there must be a Casement in that Light; and consequently that the upper Squares and lower ones must be cut somewhat shorter, (because of the Frame of the Casement,) and the Side Squares must be cut something narrower, and the four Corner-ones both shorter and narrower.

Now by such a Draught a *London Glazier*, when his Country Customers send to him for such a certain Parcel of Glafs, he knows immediately how to cut it to fit his Work, and the *Country Glazier* knows how to work up his Glafs by it; so that it shall fit each Window, though he be fifty Miles distant from it, as well as if he were by it.

The *London Glafs-Cutters* commonly mark (with a Letter or Figure over them) all the Windows that are of one Size, and write the same Mark on a Piece of Paper, which is put in among that Parcel of Squares which belong to those Lights that are all of one Size. This Piece of Paper is so put in, that the Character is visible above the Edges of the Squares; by which distinguishing Character, the *Country Glazier* readily knows which Squares to take for any Window.

I shall

I shall add, as to this Article of *Draughts*, that those *Glaziers* who understand decimal Arithmetick, set down their Dimensions in Decimals, which better suits the *London Glass-Cutters*, because they have their Rules centesimally divided for that Purpose.

For that Reason I have here set down the Dimensions of the four lower Windows in Feet, and centesimal Parts: As for Example; in the third Window, at the Top, you have these Numbers 4 50, which signify that the Height of the Light is 4 Feet, and 50 centesimal Parts; and at the Bottom there are these Numbers 1 50, which signify 1 Foot 50 centesimal Parts; and so of the rest.

Of Measuring Glazier's Work.

I shall *first* consider the Customs used among them, (for Custom is to be the greatest Guide in all manner of Measures;) and *secondly*, the taking the Dimensions, and computing the Quantity.

Note 1. That in *Glazing*, when Windows have a semicircular Top, (or any other curved Forms,) the Custom is to take the full Height as if they were square.

2. That all Windows consisting of intire Circles, or Ovals, or any other curved Form, the Dimensions are taken the two longest Ways at Right Angles one to another, and from these Dimensions the Areas are found as if they were square.

VOL. I.

3. That all Crochet Windows in Stone-Work, are all measured by their full Dimensions in Height and Breadth, as if they were square, and not curved.

4. That there is very good Reason for all these Customs, if we consider,

First, The Trouble in taking Dimensions to make them by.

Secondly, The Waste of Glass in working it to these Forms.

And,

Thirdly, The extraordinary Time expended in setting it up, more than in that of square Lights.

Of the taking Dimensions.

Glaziers generally take them to Parts of Inches, and compute to the Nicety of a Fraction of an Inch, which may be done several Ways; four of which are practised by some Surveyors and Workmen; which are, *first*, by Vulgar Fractions; *secondly*, by Cross Multiplication of Feet, Inches, and Parts; *thirdly*, by Duodecimals; and, *fourthly*, by Decimals.

But because *Glaziers* usually take Dimensions to the Parts of an Inch, the best and readiest Way to compute the Areas, is to take the Dimensions with a Sliding Rule, such as is generally used by *Glaziers*, which Rule is divided centesimally; the Dimensions being thus taken, and set down, are multiplied one into the other, as easily in Vulgar Arithmetick, as whole Numbers are.

E e

A s

As for the Manner of computing the Quantity, see CROSS MULTIPLICATION.

Of the Price of divers Sorts of Glaziers Work.

1. *Glazing with Squares*: For the Price of *French, German, Dutch, and English* Crown Glass, wrought in Lead, and set up, see before.

As to the Price of Square-Work, the Master finding Glass, and the *Glazier* Lead, Solder, and Workmanship, it is valued at about two Pence half-penny *per Foot*; but the *Country Glaziers* will be paid three Pence a Casement for pinning of them, (which is the putting of Leaden Pins through the Iron Frame, and foldering them, to fix the Glass to the Frame,) viz. Casements of four Foot and a half long, and so in Proportion, if they find Lead and Solder for it.

But for working up Squares, and setting up, and finding nothing but Workmanship, it is worth about one Penny, or three Half-pence *per Foot*.

2. *Of Glazing with Quarries*; which is for the most Part done with *Newcastle* Glass. See for the Price of new Work and Materials, what is said before in the Article *Newcastle Glass*.

But if the *Glazier* find only Lead, Solder, and Workmanship, it is worth about three Pence *per Foot*: But if they find nothing but Work, then three Half-pence or two Pence is a sufficient Price.

For taking down Quarry Glass, scowering and foldering it anew, and banding and setting up again,

the usual Price is three Half-pence *per Foot*.

But in Churches, where they say they have usually more for Banding, &c. the Price is two Pence *per Foot*; and so likewise for taking down, scowering, foldering, banding, and setting up again of old-fashion'd Work, composed of Pieces of Glass of different Sizes and Figures, the Price is two Pence *per Foot*.

Mr. *Leybourn* tells us, that in *London* they generally use that Size of Quarries called 12 s. which he describes as follows: Quarries are for the most Part six Inches in Length, from one Acute Angle to the other; and in Breadth, from Obtuse Angle to Obtuse Angle, four Inches; so that each Quarry contains twelve superficial Inches; which Sort is that they call *Long Quarries*. See QUARRIES.

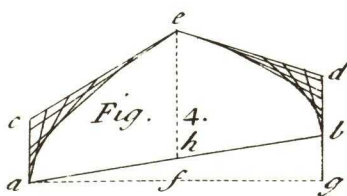
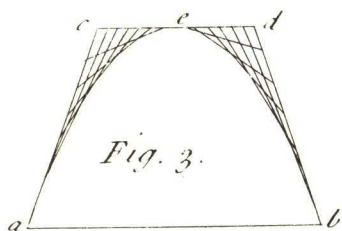
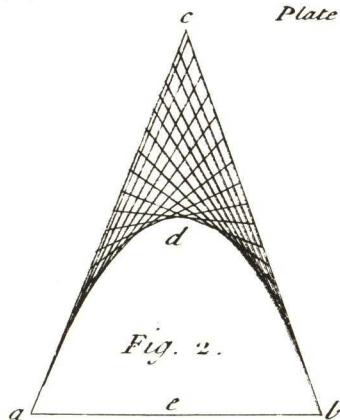
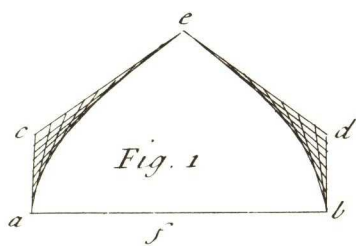
N. B. There are several Appellations given to the various Dimensions, &c. of Quarries, viz.

1. The Range, which is a Perpendicular let fall from one of the Obtuse Angles to the opposite Side.

2. And the Length is the longest Diagonal, from one Acute Angle to the other.

3. The Breadth is the shortest Diagonal, which is drawn between the two Obtuse Angles; as for the Sides, and Area of the Quarry, that is very well known to all.

You will find in the Word Quarries, that there have been, or still are twelve Sorts of Quarries, from whence arise divers Propositions





Propositions of great Use to *Glaziers*. As,

1. To find any of the five fore-cited Dimensions, as Range, Side, Length, Breadth, and Area of any of the Sort of Quarries.

2. To find the Area of any Sort of Quarries.

3. Having any of the Dimensions given, *viz.* Range, Side, Breadth, or Length, to find the Name or Denomination of the Size, *viz.* whether 8s. 10s. 12s. &c.

4. Having the Area of a Quarry given, to find of what Sort or Size it is.

5. To find whether a Window be *glazed* with those they call square Quarries, or long ones; for it is to be observed, that there are six Sorts of Sizes of square Quarries, and six Sizes of

long Quarries; which make 12 Sorts in all.

Glazier's Work is measured by the Foot square; so that the Length and Breadth of a Pane of Glass in Feet, being multiply'd into each other, produceth the Content.

It is to be noted, That *Glaziers* usually take their Dimensions to a quarter of an Inch; and in multiplying Feet, Inches, and Parts, the Inch is divided into 12 Parts, as the Foot is, and each Part is divided into 12, &c.

Example I. If a Pane of Glass be four Feet eight Inches, and three Quarters long; and one Foot, four Inches, and one Quarter broad, how many Feet of Glass does it contain?

The Decimal of $\left\{ \begin{array}{l} 8 \text{ Inches } \frac{1}{4} \\ 4 \text{ Inches } \frac{3}{4} \end{array} \right\}$ is $\left\{ \begin{array}{l} .729 \\ .354 \end{array} \right\}$

F.	I.	P.
4	8	9
1	4	3

4	8	9	
1	6	11	0
	1	2	2 : 3

4.729

1354

18916

23645

14187

4729

6.403066

Facit 6 Feet 4 Inches.

By Scale and Compasses.

Extend the Compasses from 1 to 1.354, and that Extent will reach from 4.729, to 6.4 Feet, the Content.

G L

G L

Example II. If there be eight Panes of Glaſs, each four Feet ſeven Inches three Quarters long, and one Foot five Inches and

one Quarter broad, how many Feet of Glaſs are contain'd in the ſaid eight Panes ?

The Decimal of $\left\{ \begin{array}{l} 7 \text{ Inches } \frac{3}{4} \\ 5 \text{ Inches } \frac{1}{4} \end{array} \right\}$ is $\left\{ \begin{array}{l} .646 \\ .437 \end{array} \right.$

F.	I.	P.	
4	7	9	.464
1	5	3	.437
4	7	9	33522
1	11	2 9	13938
	1	1 11 3	18584
6 : 8 :	1 : 8 :	3	6.676302
		8	8
53 : 5 :	1 : 6 :	0	53.410416

Facit 53 Feet 5 Inches.

By Scale and Compaſſes.

Extend the Compaſſes from 1 to 1.437, and that Extent will reach from 4646 to 6.676; then extend the Compaſſes from 1 to 8, and that Extent will reach from 6.676 to 53.4, the Content.

Example III. If there are ſixteen Panes of Glaſs, each four Feet five Inches and a half long, and one Foot four Inches and three Quarters broad, how many Feet of Glaſs is contained in them ?

F.	I.	P.	
4 :	5 :	6	4.458
1 :	4 :	9	1.395
4 :	5 :	6	22290
1 :	5 :	10 : 0	40122
	3 :	4 : 1 : 6	13374
6 :	2 :	8 : 1 : 6	6.218910
		4	4
24 :	10 :	8 : 6 : 0	24.87564
		4	4
99 :	6 :	10 : 0 : 0	99.50256

Facit 99 Feet 6 Inches.

It

It may be observed, that instead of multiplying by 16, I have multiplied by 4 twice, because four Times 4 is 16

By Scale and Compasses.

Extend the Compasses from 1 to 1.395, and that Extent will reach from 4.458 to 6.219; then extend the Compasses from 1 to 16, and that Extent will reach from 6.219 to 99 Feet, the Content.

It must be observed, that when Windows have Half Rounds at the Top, they are to be measured at their full Height, as if they were square. In like manner Round or Oval Windows are measured at the full Length and Breadth of their Diameters.

So also are Crocket Windows in Stone-Work measured by their full Squares.

The Reason is, that the Trouble of taking their Dimensions to work by, the Waste of Glass in working, and the Time spent in setting them up, is far more than the Value of the Glass.

GLUE. To make the best *Glue* for *gluing* the Joints of Deal Boards.

Set a Quart of Water on the Fire; then put in about half a Pound of good *Glue*, and boil them gently together over a soft Fire, till the *Glue* be entirely dissolved, and of a due Consistence; for if it be too thin, the Wood will so drink it up, that there will not remain a Body sufficient to bind the Parts together: On the contrary, if it be too thick, it will not give way for the Joint to shut close enough to be strongly joined; for though

it is *Glue* that makes the Joints stick, yet where there is so much of it, that the Joint cannot close exactly, it will never hold firm.

When *Glue* is used, it must be made thoroughly hot; for *Glue* never takes firm hold of the Wood, when it is not thoroughly hot.

And see that the Joints to be *glued* have not been touch'd with Oil or Grease; for if so, the *Glue* will never take fast hold.

The Joints of the Boards being shot true, and the *Glue* hot, set both the Faces of the Joint close together, and both turn'd upwards; then dip a Brush in the *Glue*, and besmear the Faces of the Joints as quick as possible, and clap the two Faces of the Joint together, and slide or rub them long Ways one upon another two or three Times, to settle them close, and so let them stand till they are dry and firm.

GOLDEN RULE, in Arithmetick, a Rule or Praxis of great Use and Extent in the Art of Numbers, whereby we find a fourth Proportional to three Quantities given. It is also called the *Rule of Three*, and *Rule of Proportion*.

GORGE, in Architecture, is a sort of Concave Moulding, wider, but not so deep as a Scotia, chiefly used in Frames, Chambranes, &c.

Gorge of a Chimney, is the Part between the Chambrantle and the Crowning of the Mantle. Of this there are divers Forms, straight, perpendicular, in Form of a Bell, &c.

Gorge is also sometimes used for a Moulding, which is concave on the upper Part, and con-

vex at Bottom, more properly called *Gula* and *Cymatium*.

Gorge is also used for the Neck of a Column, which is more properly called *Collarin* and *Gorgerine*.

GOTHIC Architecture is that which deviates from the Proportions, Characters, &c. of the Antique.

The *Gothic Architecture* is frequently very solid, heavy, and massive; and sometimes, on the contrary, exceedingly light, delicate, and rich. The Abundance of little, whimsical, wild, and chimerical Ornaments, are its most usual Characters. The Profiles of this are generally very incorrect.

Authors distinguish *Gothick Architecture* into two Kinds, viz. *Antient* and *Modern*.

The *Antient* is that which the *Goths* brought with them out of the North into *Germany* in the Fifth Century. The Edifices built in this Manner were exceeding massive, heavy, and coarse; from *Germany* it has been introduced into other Countries.

Those of the *Modern Gothic* run into the other Extream, being light, delicate, and rich to Excess; witness *Westminster Abbey*, the Cathedral at *Litchfield*, the Cross at *Coventry*, &c.

The last Kind continued long in use, especially in *Italy*, viz. from the Thirteenth Century, to the Restoration of the Antique Building in the Sixteenth. All the antient Cathedrals are of this Kind.

It is not to be doubted, but that the Inventors of the *Gothic Architecture* thought they had

far surpassed the *Greek Architects*. A *Greek Building* has not one Ornament, but what adds a Beauty to the Whole.

The Parts necessary to sustain or shelter it, as the Columns, Cornices, &c. derive all their Beauty from their Proportions: Every Thing is simple, measur'd, and restrain'd to the Use it is intended for.

No daring out-of-the-way Strokes, nothing quaint to impose on the Eye. The Proportions are so just, that nothing appears very grand of itself, although the Whole is grand.

On the contrary, in the *Gothic Architecture*, we see high Vaults raised on slender Pillars, which one would expect every Minute to tumble down, though they will stand for many Ages. Every Thing is cramm'd with Windows, Roses, Crosses, Figures, &c.

Gothic Column is any round Pillar in a *Gothic Building*, either too thick, or too small for its Height.

There are some of them found twenty Diameters in Height, without either Diminution or Swelling.

To draw a Gothic Arch by the Intersection of Right Lines.

First, Draw the Base Line *a b*, and divide it in the Middle at *f*, and set up the Height of the Arch from *f* to *e*; then draw the Lines *a c* and *b d* perpendicular to *a b*, and equal to half the Height of the Arch *f e*, and draw the Lines *c e* and *e d*: Then divide *a c* and *b d*

bd into any Number of equal Parts; also *ce*, *de* into the same Number of equal Parts, and draw Right Lines to every correspondent Division, as from 1 to 1, from 2 to 2, and so on, and the Interfection of those Lines create the Arch *aeb*, which was to be done. See Plate, Fig. 1.

How to draw the Gothic Arch Reverse by the Interfection of Right Lines.

First, Draw the Base Line *ab*, divide it in the Middle at *e*; then set up twice the Height of that you design the Arch shall rise from *e* to *c*, and draw the Lines *ac* and *cb*, and divide each of them into any Number of equal Parts, and draw Right Lines from Division to Division; then will those Lines create the Arch *adb*, which was requir'd. See Plate, Fig. 2.

To draw the Gothic Arch Reverse another Way.

Draw the Base Line *ab*, then draw *cd* parallel to *ab*, and distant so much as the Arch is design'd to rise; the Line *cd* is equal to half the Line *ab*, the Middle of which is at *e*: Then draw the Lines *ac* and *bd*; then divide *ac* and *bd* into any Number of equal Parts, and also *ce* and *ed*, and draw the Lines as taught before; which will make the Arch *aeb*. See Plate, Fig. 3.

N. B. The Line *cd* may be either longer, or shorter, as you have a Mind to shape

the Arch; and this Arch, and the preceding Arch, are convenient for the gathering of large Chimneys.

To draw the Gothic Arch ramping.

First draw the level Line *ga*, and divide it in the Middle at *f*; then at Pleasure erect a Perpendicular at *g* towards *d*; also from *f* towards *e*, and from *a* towards *c*; then draw the Ramp Line *ab*, and set up the Height of the Arch from *a* to *e*, also the Lines *ac* and *bd*, and draw the Lines *ce* and *de*; then divide the Lines *ac* and *ce* into any Number of equal Parts; also the Lines *be* and *de*, and draw the Right Lines, as before taught, which will describe the Arch *aeb*; which was the Thing to be done. See Plate, Fig. 4.

GOUGE, an Instrument used by divers Artificers, being a Sort of round hollow Chissel, used in cutting Holes, Channels, Grooves, &c. in Wood, Stone, &c.

GRADATION, in Architecture, signifies a Place by which we go up by Steps, particularly an Ascent from the Cloister to the Choir in some Churches. Also an artful Disposition of several Parts, as it were, by Steps or Degrees after the Manner of an Amphitheatre; so that those which are placed before do no Disservice, but are rather serviceable to those behind.

Gradation, in Painting, is used to signify an insensible Change of Colour, by the Diminution of the Tints and Shades.

GRANARY, a Place for laying up or storing Corn in, particularly

ticularly, for keeping a considerable Time.

Sir *Henry Wooton* advises to make it look towards the North, as much as may be, because that Quarter is the coolest and most temperate.

Mr. *Worlidge* observes, that the best *Granaries* are built of Brick, with Quarters of Timber wrought in the Inside, to which the Boards may be nailed; with which the Inside of the *Granary* must be lin'd so close to the Bricks, that there may not be any Room left for Vermine to shelter themselves. There may be many Stories one above another, which should be near the one to the other; because the shallower the Corn lies, it is the better and more easily turn'd.

Some have had two *Granaries* one above the other, and have filled the upper with Wheat, or other Corn.

The upper one having a small Hole in the Floor, by which the Corn fell down into the lower one, like the Sand in an Hour-Glass, which, when it was all come down into the lower *Granary*, it was then carried up again into the upper one; and by this Means was kept continually in Motion, which is a good Preservative for the Corn.

A large *Granary* full of square Wooden Pipes may keep Corn from heating.

GRANGE, an antient Term for a Barn, wherein to lay up and thrash Corn. The Word is sometimes also used in a more extensive Sense for the whole Farm, with all the Appendages, as Barns, Stables, Stalls, and other necessary Places for Husbandry.

GRATICULATION, a Term used by some for the dividing a Draught or Design into Squares, in order to the reducing it thereby.

GRAVITATION is the Exercise of Gravity, or it is the Pressure that a Body, by the Force of its Gravity, exerts on another Body under it.

It is one of the Laws of Nature discovered by Sir *Isaac Newton*, and now received by most Philosophers, that every Particle of Matter in Nature *gravitates* towards every other Particle; which Law is the Hinge whereon the whole *Newtonian Philosophy* turns.

All Bodies are mutually heavy, or *gravitate* mutually toward each other; and this Gravity is proportional to the Quantity of Matter; and at unequal Distances, it is inversely as the Square of the Distance.

What is called by us *Gravitation*, with respect to the *gravitating* Body, is called *Attraction* with respect to the Body *gravitated*.

GRAVITY, in Mechanics, is the Conatus or Tendency, or that Force by which Bodies are carry'd or tend towards the Centre of the Earth.

That Part of Mechanics which considers the Motion of Bodies arising from Gravity, is peculiarly called *Statics*. See *STATICS*.

Gravity is distinguish'd into *Absolute* and *Relative*.

Absolute Gravity, is that where-with a Body descends freely through another resisting Medium; or it is the whole Force, by

by which any Body tends towards the Centre of the Earth.

Relative Gravity is that wherewith a Body descends after having spent part of its Weight in overcoming some Resistance.

Such is that wherewith a Body descends along an inclin'd Plane, where some Part is employed in overcoming the Resistance or Friction of the Plane.

Accelerate Gravity is the Force of *Gravity*, considered as growing greater, the nearer it is to the attracting Body or Point.

Gravity or *Weight*, is the Heaviness of Matter, and is the natural Inclination which is in heavy Bodies to move downwards when they are not sustain'd or held up, and fall towards the Centre of the Earth.

And for this Reason, the Centre of the Earth is called, *The Centre of Heavy Bodies*.

The Centre of *Gravity* of a heavy Body, is a Point by which a Body being suspended, all its Parts which are about that Point, will balance one another, and oppositely hinder one another from falling, whereby the Body will remain in any given Position.

Whence it is plain, that a liquid Body cannot of itself have any Centre of *Gravity*, because its Parts are not fixed to one another, but are in a continual Motion, as Water, Wine, Beer, &c.

The Centres of *Gravity* and *Magnitude* cannot be in the same Point, but in a Body which is Homogeneous.

A Homogeneous Body is one whose Matter is uniform,

and every where of the same Weight about its Centre of Magnitude, which is a Point in that Body as far distant as can be, and equal from all its Extremities, which the Matter that composes our Earth is known to be otherwise: Some being of Earths, Metals, Minerals, Water, &c. the specific *Gravities* of which are very different; and therefore the Earth, or any other Body, whose Parts or Matters are of different Weights in different Parts, are called Heterogeneous Bodies.

Specific Gravity of a Body is that which proceeds from the natural Density of the Parts of its Matter, which makes one Body weigh more than another of the same Dimensions or Magnitude.

As for Example: The *Specific Gravity* of Gold is greater than that of Lead, &c.

The *Specific Gravity* of heavy Bodies is either *Absolute* or *Relative*.

First, Absolute. The absolute Weight of a heavy Body is the Force which it has to descend freely into a fluid Medium, as in Air, or Water, when it touches nothing else but the Parts of that Medium. Thus the Weight of a Stone which in the Air is called absolute, from its own Force which it has to descend freely, when it touches nothing but the Aerial Particles through which it falls.

Secondly, The Relative Weight of a heavy Body, is the Force which such a Body has to descend when it touches something else, more than the Parts of the Medium, as when it bears on an inclin'd

Plane, as A on B, or on the End of a Lever, as the Body E on the Lever F G, where it often happens that the Body in Question becomes a Counterpoise to a greater and heavier Body, as the Body C, as it is nearer or farther from the Centre of Motion D, on which the Lever moves. See Plate, Fig. 1. and 2.

This Counterpoise of Bodies is called *Equilibrium*.

Now 'tis plain, that the Body H, (in the first Figure,) which is supposed equal to the Body A, in falling to K, must fall with greater Force than the Body A; because that the Body H has no other Resistance than that of the Air: But the Body A has the Resistance of the inclin'd Plane K I, and Air also.

Therefore it is evident, that the *Absolute Weight* of any Body is greater than the *Relative Weight*.

Note, That the Centre of Motion in a Lever, is that Point whereon it rests, and moves; as D, in a Balance, Fig. 2. is that Point which it hangs by, as the Point B of the Balance A C, Fig. 3 and in a heavy Body, it is that Point by which a Body is held, and about which it may be mov'd, as the Points or Centres of the Circles, square and equilateral DEF.

As to the Powers by which all Bodies are mov'd by the following Engines, and the Application to Practice, see POWER.

Centre of GRAVITY.

THEOREM I. See Plate, Fig. 4.

If a Power, as L, whose Line of Direction is perpendicular to the Lever L I B, equipoise the Cube D M, whose Centre of Gravity *d* is above the Lever, its Power will be increased, as the said Cube is raised above A, and decreased, as the said Cube is let lower to Q, &c.

The Cause of this is very plain; for by the Body's Change of Place, the Line of Direction of both Power and Body are remov'd, whereby their Distances from the Fulcrum are not in the same Ratio as before.

First, Suppose the Cube *dm* on the Lever B L to be remov'd to Q, then 'tis plain that its natural Line of Descent or Direction *dm* will become *da*; wherefore the Bearing of the whole Weight is at *a*, which is as much further from the Fulcrum L, as the Line *am*.

Secondly, Suppose the Cube *dm* on the Lever B L to be raised as far above B to A, as it was before depressed from B to Q, then will its Line of natural Direction or Descent *dm* become *dn*.

Thirdly, Since the Cube at A is at the same Distance from B as Q is from B, therefore the other Ends K and P will also be equidistant from L; and therefore if the Right Line K P be drawn,

drawn, it will cut the Lever BL at Right Angles in Z.

Wherefore the Distance IZ is = the Distance of the Powers in both the Levers KQ and AP.

But since that by continuing the Lines of Direction *da* and *dn* up to the Lever BL, they meet at unequal Distances from the Fulcrum in *x* and *g*; therefore the Cube at A, whose Distance *g*I is the least from the Fulcrum, I requires less Weight than the Cube at Q, whose Distance *x*I is greater.

Fourthly, Now seeing that a lesser Power is required at P than at K, 'tis evident, that the same Power will equipoise a greater Weight; and therefore the Power L, in raising the Cube to A, is increased; and, on the contrary, as aforesaid, the Power L, in letting down the Cube to Q, is decreased QED.

This is the first Variety of the Effects of raising Bodies.

I shall next proceed to the second, wherein, by having the Centre of Gravity placed below the Lever, the Power is decreased when the Body is raised out of a horizontal Position, and increased when let fall below the horizontal Position.

This being the contrary to the preceding, may, perhaps, at first Sight, appear impossible. But, observe. See Plate, Fig. 5.

First, That all Things being equal, as before, the Distance of the Powers in the Levers BF and EC are equal to HI; but the Distances of the Weights F and C are unequal; that of the Lever BF being at *b*, and that of the Lever EC being at *x*.

Now seeing that the Distance of the raised Weight, which is the Point *x*, is farther from the Fulcrum I, than the Distance of the let-fallen Body F, which is the Point *b*, and both the Distances of Power equal to one another, 'tis plain, that the Power at K will be increased, and that at H decreased. QED.

Now from the preceding Rules, and those Remarks on the Manner of placing Bodies on a Lever, it is impossible, but that at all Times you may easily raise any heavy Body with the least Power, and in the least Time; which is the chief Work of Mechanicks, and are very useful to be known by Architects; for a good Architect ought to be a good Mechanick.

GREEN-HOUSE, or *Conservatory*; a Place built for depositing exotick Plants, and such as will not bear the Winter's Cold in our Climate.

These Sorts of Houses, as they are commonly built, serve more for Ornament than Use: Their Situation towards the South Sun is the only Thing that seems to be regarded towards the Health of the Plants they are to shelter.

It is rare to find one among them that will keep a Plant well in the Winter, either by reason of their Situation in moist Places, their Want of Glasses enough in the Front, and the Disproportion of the Room within them; and sometimes, where it happens that a *Green-House* has been considered in these Points, all is confounded by the Flues under it, which convey the Heat from the Stoves.

Besides

Besides what is commonly called a *Green-House*, it has been customary to provide Glass Cases of several Kinds, and Stoves, for the Preservation of Plants brought from different Countries.

But an ingenious Author has found them to be so many unnecessary Expences; and that a good *Green-House*, well contrived, will do all that is required for the Welfare of any Plant in the Winter; and that it may be so ordered, as to shelter at one Time Orange-Trees, Plants from the *Cape of Good Hope, Virginia, Carolina*, and indeed such as grow within ten Degrees of the Line.

The same Author says, that when he was first acquainted with Aloes, *Indian Figs*, and such like Plants, he confesses he thought they could never have Heat enough, and that he destroy'd many by that too common Notion; he could hardly venture them out of the Hot-Beds in the most extreme Heats of Summer; and that in the Winter, they were half-roasted with subterraneous Fires he made under the Glass Cases where they stood.

A good *Green-House* ought to be situated on the driest Ground, to be as free from Damps as possible; substantial Provision ought likewise to be made for keeping out the Cold, and yet upon Occasion to let in Air freely; but chiefly to contrive that the Front of the House be so disposed, that nothing may obstruct the Passage of the Sun's Rays, in the Winter, into the House.

It is generally allowed, that the South Aspect is the best for a *Green-House*, as it will in that Exposure receive the Sun for the greatest Part of the Day; but in case that cannot be had with Conveniency, the South-West Aspect is next to be covered; and it would be pleasant, as well as beneficial to Plants, if the Conservatory was always joined to the Dwelling-House.

Nothing can be more agreeable in Winter, than to have a View from a Parlour or Study through Ranges of Orange-Trees, and curious Plants of foreign Countries, blossoming and bearing Fruit, when the Gardens without Doors are, as it were, in a State of Death; and to walk among those Curiosities of Nature, as in the most temperate Climate, without any Sense of the Frost, or pinching Cold that reigns abroad; and besides, there is this Conveniency in joining the Conservatory to the House, that in cold Weather you may go into it, without letting in the cold Air, or blighting Winds from abroad.

Thus much as to the Situation: The next Thing to be considered is the Proportion of the Building, and that chiefly in Relation to the Height and Breadth of the Room; which a certain Author directs, that for the better Admission of the Sun's Rays to pass all over the House, the Breadth of it be no more than the Height from the Floor to the Ceiling, which may be from ten to eighteen Feet.

That the Walls towards the North and the East, be of a good Thickness, and the Front towards

wards the South be all of Glas, except a low Wall about a Foot high from the Ground; that there be no Piers of Brick-Work or Timber in the glaz'd Part, for they cast more Shade into the House, in Proportion to their Bigness, than it can receive Light through the Glas; whereas, every one who understands exotick Plants will allow, that they should have all the Advantages of the Sun's Rays in Winter, that they possibly can receive: And for this End, he is of Opinion, that it would be proper, in the colder Parts of *England*, to build the Front of a *Green-House* in a Sweep, or in the Form of a Semicircle, which would then receive the Rays of the Sun from the Time of its Rising, till its Setting.

That the Glas in the Front, whether it be in Sashes or Casements, be so contrived, that it may either be made to slide quite below or above the Frames, or to be taken away, as Occasion shall offer, to give Air to the Plants, which for about a Fortnight or three Weeks after they are set into the House, and as long before the Plants come abroad, should be quite open Night and Day, if the Frosts or blighting Winds are not abroad.

Some have practis'd, with good Success, to lay the Windows of their *Green-Houses* sloping about ten Inches; but he is of Opinion, that they will do as well upright.

He advises, that the Door be in the Middle of the Front, and at least four Foot wide, to admit large Plants; that it be glaz'd, to which strong Shutters should

be added, at least an Inch thick, which in the Winter Time should be shut every Night, for fear of Frost; and also in extraordinary cold Weather, when violent Winds blow right against the House.

That for the better Security of the Plants from Cold, a Place for the laying up the Gardiner's Tools be built at the *Green-House*, and over it a Fruiterie or Seed-Room, or in the Lieu of the latter, the Room may be fill'd with dry Straw.

The best Pavement for a *Green-House*, he says, is that made with square Tiles, which quickly sucks up Wet, and never sweats, as Marble, or such Kinds of hard Stone usually do; and that for lining of the Walls, nothing is preferable to *Dutch* glaz'd Tiles, which are soon warmed with the Sun, and reflect a great Heat into the House.

That in the Disposition of the Shelves in the *Green-House*, one Third of the Floor be allowed for them to stand upon, one Third from the first Shelf to the Windows, and as much from the last Shelf to the Back of the House; so that a Person may walk round the Plants, which being placed in the middle Line of the House, are safe from the extreme Cold, which is generally nearer the Walls or Glasses.

The Chimney for warming the Air, he directs to be built between the Windows and the first Shelf at one End of the House, about a Foot above the Floor, which will rise afterwards, and spread itself over the Whole.

But

But the ingenious Mr. *Philip Miller* has given us a more accurate Design of a *Green-House*, which he describes as follows :

As to the Length of the House, he says, that should be proportioned to the Number of Plants it is to contain, or the Fancy of the Owner; but as to the Depth, that should never be more than sixteen Feet in the Clear, and the Length of the Windows should be at least equal to the Depth of the House; and if they are something longer, it will be still the better.

These Windows should be carried up quite to the Ceiling, that there may be no Room for dead Air in the upper Part of the House, and they ought to come down within about ten Inches or a Foot of the Floor; their Breadth should be proportioned to the Length of the House, which in a small *Green-House* may be four Feet broad, but in a large one they should be six Feet.

The Piers between these Windows should be as narrow as possible they may be, to support the Building, for which Reason he chuses to have them either of Stone or solid Oak; for if they are built with fine rubbed Bricks, they are generally so soft, that the Piers will require to be made thicker than can be allow'd, otherwise the Building will be in danger of falling in a short Time, especially if any Rooms be built over the *Green-House*; which would be of great Use in keeping out the Frost in very hard Winters.

If the Piers are made with Stone, he directs that they be

twenty Inches broad in Front, and sloped off backwards to about ten Inches broad; whereby the Rays of the Sun will not be taken off, or obstructed by the Corners of the Piers; which it would be, if they were square.

And if the Piers are made of solid Oak, eighteen Inches square he accounts strong enough to support the Building; and also sloped off, after the Manner before directed as to those of Stone.

A Tool-House may also be erected at the Back of the Building, which may also serve for many other Purposes, and will also be extremely useful, by preventing Frost from entering that Way; so that the Wall between these need not be more than two Bricks in Thickness; whereas if it were quite exposed, behind it ought to be two Brick and a half, or three Bricks in Thickness.

And thus also, if you have a Mind to make a handsome Building, and to have a noble Room over the *Green-House*, you may make the Room to come over the Tool-House, and carry up the Stair-Case in the Back, so as not to be seen in the *Green-House*: And by this Means you have a Room twenty or twenty-two Feet in Width, and of a proportionable Length.

And under this Stair-Case there may be a private Door into the *Green-House*, at which the Gardiner may enter in hard frosty Weather, when it will not be safe to open any of the Glasses in the Front.

The Floor of the *Green-House* may be laid with Marble, Stone,

or broad Tiles, according as the Owner pleases, and must be raised two Feet above the Level of the Ground on which the House is situate, which will be sufficient, if the Soil be dry; but if moist and springy, and thereby subject to Damps, it will be necessary to raise it at least three Feet above the Surface.

He advises also, to make a Flue of about ten Inches in Width, and two Feet in Depth, under the Floor, about two Feet from the Front; which Flue is to be carried the whole Length of the House, which may be returned along the back Part, and be carried up in proper Funnels adjoining to the Tool-House, by which the Smoak may pass off.

The Fire-Place may be contriv'd at one End of the House, and the Door at which the Fuel is put in, as also the Ash-Grate, may be contrived to open into the Tool-House; so as to be quite hid from the Sight, and be in the dry; and the Fuel may be laid in the same Place, and so will always be at Hand for Use.

He also advises to have good strong Shutters to the Windows in the Front of the *Green-House*, hung on Hinges to fold back, so that they may fall back quite close to the Piers, so as not to obstruct the Rays of the Sun.

These Shutters may be an Inch thick, or a little more, made to join so close, as to be able to keep out our common Frosts; and when the Weather is so cold as to endanger the freezing in the House, it is but making a

Fire in the Flue, and that will effectually prevent it.

The back Part of the House should be plaistered with Mortar, and white-wash'd; or if lined with Wainscot, should be painted white, as should the Ceiling, and also every Part within the House; for White reflects the Rays of Light in a much greater Quantity, than any other Colour; and is of very great Service to Plants, especially in the Winter Season, when the House is pretty much clos'd, so that but a small Share of Light is admitted through the Windows: For he says, he has observed, that at such Times, where a *Green-House* has been painted black, or any dark Colour, the Plants have cast most of their Leaves.

He adds, that to avoid the Inconvenience which attends the placing Plants of very different Natures in the same House, it will be very proper to have two Wings added to the main *Green-House*, which will greatly add to the Beauty of the Building, and also collect a greater Share of Heat.

The *Green-House*, according to his Plan, is placed exactly fronting the South, and one of the Wings faces the South-East, and the other the South-West; so that from the Time of the Sun's first Appearance upon any Part of the Building, until it goes off at Night, it is constantly reflected from one Part to the other, and the cold Winds are also kept off from the Front of the main *Green-House* hereby.

And in the Area of this Place you may so contrive, as to place many

many of the most tender exotick Plants, which will bear to be exposed in the Summer Season; and in the Spring, before the Weather will permit you to set out the Plants, the Beds and Borders of this Area may be full of Anemonies, Ranunculus's, early Tulips, &c.

In the Centre of this Area may be contrived a small Basin for Water, which will be very convenient for watering Plants, and will also very much add to the Beauty of the Place; besides, the Water being thus situated, will be softened by the Heat which will be reflected from the Glasses upon it, whereby it will be render'd much better than raw cold Water for tender Plants.

The two Wings of the Building should be so contrived, as to be fit for placing Plants of different Degrees of Hardness, which must be effected by the Situation and Extent of the Fire-Place, and the Manner of conducting the Flues. For which, see the Articles STOVES.

The Wing facing the South-East should always be preferred for the warmest *Stove*, its Situation being such, as that the Sun, upon his first Appearance in the Morning, shines directly upon the Glasses; which is of great Service in warming the Air of the House, and adding Life to the Plants, after having been shut up during the long Nights in the Winter Season.

These Wings may be allow'd sixty Feet in Length, and may be divided in the Middle by Partitions of Glass, with Glass Doors to pass from one to the other.

And the Fire-Place may be so ordered as to warm both Divisions, by placing an Iron Regulator in the Flue, so that the Smoak may pass through the Flues of which Part soever you please.

By this Contrivance you may keep such Plants as require the same Degree of Heat in one Part of the House, and those which will thrive in a much less Warmth in the other Part; but this will be more fully explained under the Article STOVE.

The other Wing of the House facing the South-West, may also be divided in the same Manner, and Flues carried through both Parts, which may be used according to the Seasons, or the particular Sorts of Plants which are placed therein.

So that by this Disposition here will be four Divisions in the Wings, each of which may be kept up to a different Degree of Heat; which, together with the *Green-House*, will be sufficient to entertain Plants from all the several Countries of the World.

And without having these several Degrees of Warmth, it will be impossible to preserve the various Kinds of Plants from the several Parts of *Africa* and *America*, which are every Year introduced into the *English* Gardens.

For when Plants from very different Climates are placed in the same *Green-House*, some perish for want of Heat, while others are destroy'd by having too much of it; and this is often the Case in such *Green-Houses*, where there are large Collections of Plants.

To GRIND Colours in Oil :

Let the *Grinding-Stone* be placed about the Height of your Middle, let it stand firm and fast, so that it joggle not up and down ; then take a small Quantity of the Colour you intend to *grind*, (two Spoonfuls is enough,) for the less is *ground* at a Time, the easier, and finer, will the Colour be *ground*.

Lay these two Spoonfuls of the Colour in the Middle of the Stone, and put a little Linseed Oil to it, (but take Care not to put too much at first;) then mix it together a little with the Muller, and turn the Muller five or six Times about ; and if you find there be not Oil enough, put a little more, and *grind* it till it come to the Consistence of an Ointment, or appears free from any Sort of Lumps, and smooth as the most curious Sort of Butter ; for it *grinds* much better and sooner when it is stiffish, than when it is so thin as to run about the Stone ; and in *grinding*, you must often bring the Colour that has spread together into the Middle of the Stone with a Piece of Lanthorn Horn.

And in *Grinding* hold your Muller down as hard as you can, and also move it with such a Slight, as to gather the Colour under it ; and that no Knots or Grittiness remains, and that it is become as fine as Butter itself.

When it is *ground* enough, cleanse it off the Stone with the Horn into a Gallipot or Pan, and lay on more Colour, and proceed as before, till you have *ground* what Quantity you want.

VOL. I.

If you *grind* a considerable Quantity, to be used not till some Time after, put it into Bladders, tie it up close, and hang it up.

Those who care not for the Trouble to *grind* the Colours, may have all Manner of Colours ready *ground* at Colour Shops.

How to order Colours for working, after they have been ground.

When you use Colours, you must add more Oil to them, but not so much as to make them so thin, that they will let the Ground be seen through them, or run about ; and if your Colour be as stiff as it ought to be, once doing will be more than twice doing with thin Colour.

Painters make use of a common Fraud and Deceit, when they agree to do Work by the Yard at a common Price, to be coloured three Times over. In painting with such thin Colours that at three Times doing over, it is not so substantial as one Time would be, if the Colour had a thick and substantial Body.

Three Times colouring with substantial and well-bodied Colour, will last ten Times as long as that which has been so slightly coloured.

The Priming Colour indeed ought to be very thin, that it may have Oil enough to penetrate into the Wood, which tends much to its Preservation ; but the second must be thicker than the first.

G R

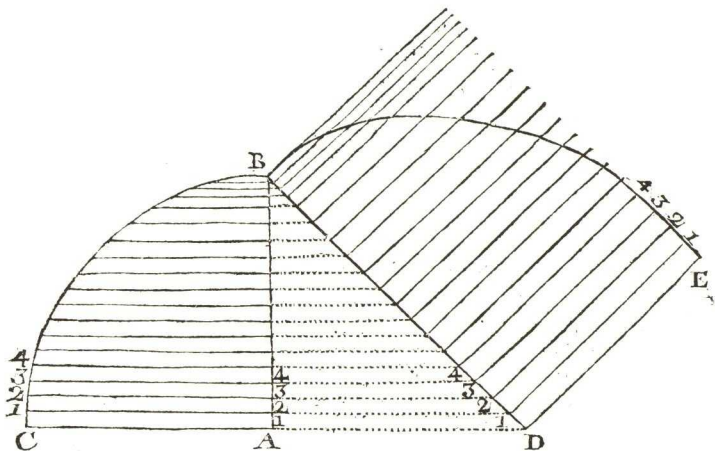
To find the Angle of a regular GROIN, or MITER BRACKET of a Cove.

First, Draw the Line of Projection AB, also the Mitre Line DB; then will AD be at Right Angles with AB; then from A strike the Quadrant CB, and draw the Line AC, which will be at Right Angles with AB; divide AB any how, either into equal or unequal Parts, and from those Divisions raise Perpendiculars from the Line AB to touch the Arch BC: Also continue these Right Lines to cut the Mitre Line BD, as you see by the dotted Lines, which will divide the Line DB into the same Number of Parts, and in Proportion with the Line AB; then from those Divisions made

G R

by the dotted Lines on the Line DB, raise Perpendiculars at Pleasure, and take the Line AC in your Compasses, and set it up the first Line, as from D to E; then take the Line 1, 1, on the Quadrant, and set it up the Line 1, 1; also from 2, 2, to 2, 2, from 3, 3, to 3, 3, and from 4, 4, to 4, 4, and so on, till the Points are laid down; into which Points you must strike Nails; then bend a thin Lath round them, and by its Edge strike the Arch for the Groin or Mitre Bracket EB.

N. B. This is work'd in the same Manner, let the given Arch B be what it will, or let the Line BD be true Mitre, or irregular.



To make Centres for regular or irregular Groins, so that the Mitres shall be true.

This Figure represents an irregular Groin, because *ab* is longer than *ac*.

Let the Arch *efd* be given, and let the Curve be what you will.

What must be the Curve of *akc*, so that when the two different Centres are set in their Places, their Mitre or Angle shall

shall be perpendicular over the Angle Line ad ?

Or if the *Groin* be of Wood for the Ceiling of a Room, then you must find the Arch dba , which must be your Hip to fasten the other Ribs to.

First, Describe the Figure $abcd$, and draw the Line ad ; then strike the Arch efd from the Point e , and divide the Line cd any how; from which raise Perpendiculars to touch the Arch efd , and continue those Perpendiculars to the Line ad , as by the dotted Lines which divides the Line ad into the same Number of Parts, and in Proportion to cd ; then from those Divisions created by the dotted Lines, raise Perpendiculars at Pleasure from the Line ad : Having done this, lay your square or parallel Ruler at Right Angles with the Line ac ; and from the Divisions on the Line ad , draw Perpendiculars from the Line ac of a Length at Pleasure, which will divide the Line ac into the same Number of Parts, and in Proportion with those on the Lines cd and ad ; then you must take the Line $1, 1$, on the Arch efd , and set it on the first Perpendiculars on the Lines ad and ac , as from 1 to 1 ; and so that every Line marked with the same Figures are of an equal Length, as $1, 1$, to $1, 1$, = $2, 2$, to $2, 2$, $3, 3$ = $3, 3$, $4, 4$ = $4, 4$, also gb and ik to ef ; and so of the other Lines, as they follow.

And when the Points $1, 2, 3, 4$, and all the rest are found by the foregoing Method, you must strike a Nail in every one of them, and bending a thin Lath

round them, draw the Arches akc and abd , and those you find will answer the Purpose designed. See the Plate.

How to prepare the Boarding for the Covering of the Centres of any Kind of Groins, and to cut them to their right Lengths and Bevels, before the Centres are set in their Position.

Let ABCD represent the Plan of an irregular *Groin*; draw the Curves of the two different Centres BFC and CDG, by the Rule laid down in the foregoing Figure for making of Centres of *Groins*, &c. in the preceding Figure.

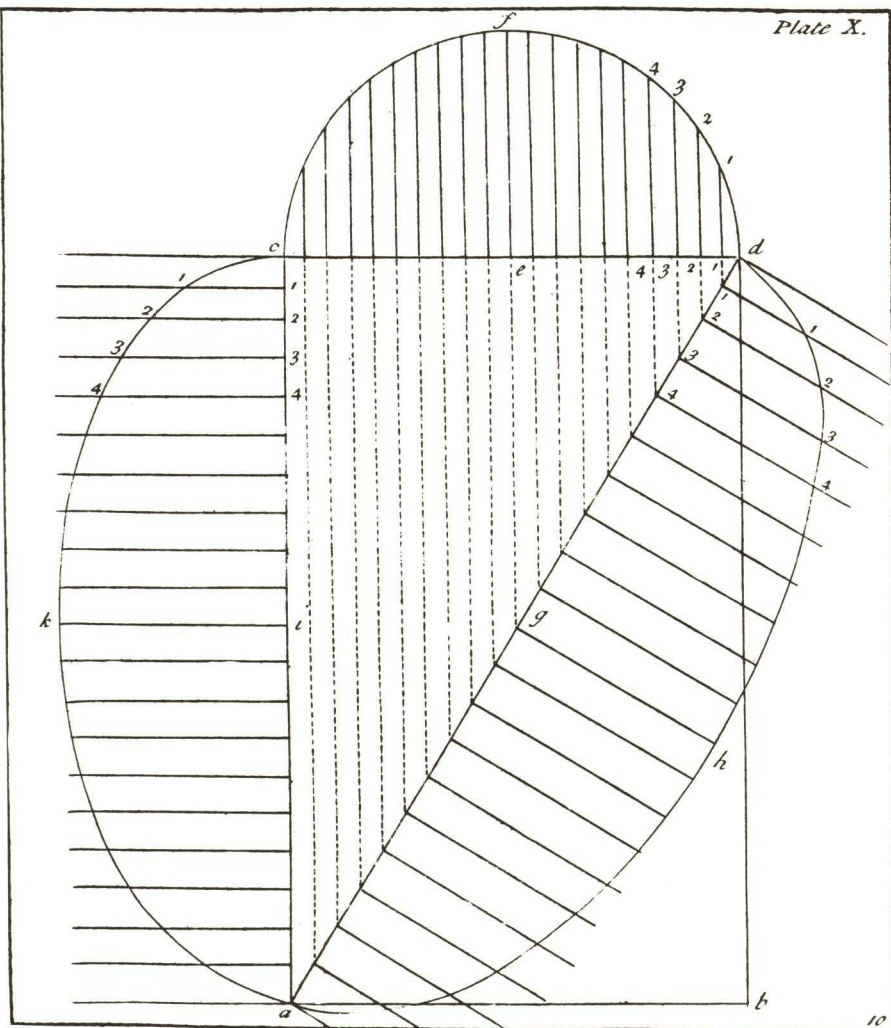
Then continue the Line BC both Ways from B to I and from C to K, so that IK be equal in Length to the Girt of the Curve BFC; and draw IH and KH, which are each equal in Length to the Girt of the Curves at the *groining* or *mitering* of the two different Centres; and draw the Lines IO and KP perpendicular to IK.

Then will the Plane HIOPK be equal in Quantity to the Back of the Centre BFC.

To find the Bevels of the Boards, lay them all down together, just as many as will fit between the Lines IO and CP, letting their Ends reach over the Lines IH and HK.

Then strike a Line on their Ends, as from I to H, and from H to K, which is the true Bevel of every Board that covers the Centre BFC; and for those on the Centre CDG, do in the same Manner. As for Example:

Ff 2 Produce



Things turned and distorted out of the Way of Nature, so as to raise Surprise and Ridicule.

Grotesk Work is the same with what is sometimes called *Antique*. The Name is said to have taken its Rise hence, that Figures of this Kind were in antient Times much used in adorning the Grotto's, wherein the Tombs of eminent Persons or Families were inclosed; such as that of *Ovid*, whose Grotto was discovered near *Rome* not sixty Years since.

GROTESQUES } are used
GROTESKS } particularly to signify those fanciful Ornaments of Animals, interspers'd among Foliages, Fruit, &c. as those painted by *Raphael Urbin* in the *Vatican*, and those carved by *Michael Angelo*, in the Ceilings of the Portico of the Capitol.

These Kind of Compartiments are called, by *Vitruvius Harpagenituli*.

GROTTO } is a large, deep
GROTTA } Cavern or Den in a Mountain or Rock.

Grotto is also used for a small artificial Edifice made in a Garden, in Imitation of a natural *Grotto*.

The Outfides of these *Grotto's* are usually adorned with Rustick Architecture, and their Inside Shell-Work; and also furnished with various *Jet d'Eaux*, or Fountains, &c.

GROUND to build on. See FOUNDATION.

GROUND, in Painting, is used to signify the Surface upon which the Figures and other Objects are raised and represented.

The *Ground* is properly understood of such Parts of the Piece, as have nothing painted on them; but retain the original Colours upon which the other Colours are applied to make the Representations.

A Building is said to serve as a *Ground* to a Figure, when the Figure is painted on the Building.

GROUND GUTS. See ALDER.

GROUNDSELL, or PLATE. See SELL.

GROUND-PLAT, or PLOT, a Piece of *Ground* on which a Building is to be erected.

GROVE } in Joinery, &c.

GROOVE } a Term used to signify the Channel that is made by their Plough in the Edge of a Moulding, or Stile, or Rail, &c. to put their Pannels in, in Wainscotting.

GROUP, in Painting, Sculpture, &c. is a Term used to express the Assemblage or Knot of two or more Figures of Men, Beasts, Trees, Fruits, or the like, which have some apparent Relation to each other.

A *Group of Columns*, in Architecture, is used when we speak of three or four Columns joined together on the same Pedestal; but when there are but two, the Word *Couple* is used, and not a *Group of Columns*.

GRY, a Measure containing one Tenth of a Line.

A Line is one Tenth of a Digit, and a Digit one Tenth of a Foot, and a Philosophical Foot one Third of a Pendulum, whose

Diadromes or Vibrations, in the Latitude of forty-five Degrees, are each equal to one Second of Time, or one Sixtieth of a Minute.

GUEULE, in Architecture.
See GULA.

GULE } in Architecture,
GULA } a wavy Mem-
GOLA } ber, the Contour of which resembles the Letter S, which the *Greeks* call *Cymatium*, *q. d.* a little Wave; and our Architects an *Ogee*.

This Member is of two Kinds: *Recta* and *Inversa*.

The first and principal has its Cavities or Hollows above, and Convexities below. This always makes the Top of the Corona of the Cornice, jetting over the Drip of the Cornice, like a Wave ready to fall.

It is called *Gula Recta*, and by the *French*, *Doucine*.

It is sometimes called absolutely the *Entablature*, as being the first or uppermost Member of it.

The second, or *Gula Inversa*, is exactly the Reverse of the former, the Cavity or Hollowness of it being at the Bottom; so that with respect to the former, it appears inverted. This is used in the Architrave, and sometimes in the Cornice, along with the former, only separated by a Reglet.

Some derive the Term *Gula* from the Resemblance these Members bear to the *Gula*, or Throat of a Man: Others from *Gules*, a Term in Heraldry, as supposing the Moulding form'd from the antient Manner of wear-

ing their Garments, which consisted of Slips, or Swathes, alternately, Furr and Stuff of various Colours; the Intervals between which were *Gules*, or *Guales*.

GUNTER's LINE, is a Line of Numbers which is upon the ordinary Two-Foot, or Eighteen-Inch Rules, commonly used by Carpenters, Joiners; &c.

This Line being the Scale recommended to in those Operations in this Book, that are wrought with Scale and Compasses, I shall give some Directions for the Use of it, as follows:

If the Number you would find on the Line, consists only of Unites, then the Figures upon the Line represent the Number sought. Thus if the Number be 1, 2, 3, &c. then 1, 2, 3, &c. upon the Line, represents the Number sought. But if the Number consists of two Figures, that is, of Units and Tens, then the Figure upon the Rule stands for Tens, and the larger Divisions stand for Units: Thus, if 34 were to be found upon the Line, the Figure 3 upon the Line is 30, and 4, of the large Divisions, (counted forward,) is the Point representing 34; and if 340 were to be found, it will be at the same Point upon the Line; and if 304 were to be found, then the 3 upon the Line is 300, and 4, of the smaller Divisions, (counted forward,) is the Point representing 304. If the Number consists of four Places, or Thousands, then the Figure upon the Line stands for Thousands, and the larger Divisions are Hundreds,

reds, the lesser Divisions are Tens, and the Tenth Parts of those lesser Divisions are Units.

Thus, if 2735 were to be found, then the 2 is 2000; and the 7 larger Divisions (counted forward) is 700 more; and 3 of the lesser Divisions is 30 more; and half of one of the lesser Divisions is 5 more, which is the Point representing 2735. You must remember, that between each Figure upon the Line there are 10 Parts, which are called the larger Divisions; and each of those larger Divisions are subdivided (or supposed so to be) into 10 other Parts, which are called the smaller Divisions; and each of those Parts supposed to be subdivided again into 10 other Parts, &c. You must also remember, that if one in the Middle of the Line, stands only for 1, then 1 at the upper End will be 10, and 1 at the lower End will only be $\frac{1}{10}$; but if 1 at the lower End signifies 1, then 1 in the Middle stands for 10, and 1 at the upper End is 100, &c.

There is one Thing more which I would have my Reader to understand; and that is, how to find all such proportional Numbers made use of in the Proportions about a Circle, and of a Cylinder, and in other Places; which Thing may be of good Use, to know how to correct a Number which may happen to be false printed, or to enlarge any Number to more decimal Places, for more Exactness; for though it is mentioned what such Numbers are, yet it has not been shewn how to find them; which a Learner may be a little at a

Nonplus to do; though they are easily found by the Rules there laid down. I shall therefore give two or three Examples, in this Place, of finding such Numbers, which may enable my Reader to find out the rest.

And, first, let it be required to find the Area of a Circle, whose Diameter is an Unit.

By the Proportion of *Van Cullen*, if the Diameter be 1, the Circumference will be 3.1415926, &c. whereof 3.1416 is sufficient in most Cases. Then the Rule teaches to multiply half the Circumference by half the Diameter, and the Product is the Area, that is, multiply 1.5708 by .5, (*viz.* half 3.1416 by half 1) and the Product is .7854, which is the Area of the Circle whose Diameter is 1.

Again, if the Area be required, when the Circumference is 1, first find what the Diameter will be, thus, as 3.7416 : 1 :: 10 is 1 to .318309, which is the Diameter when the Circumference is one. Then multiply half .318309 by half 1, that is .159154 by .5, and the Product is .079577, which is the Area of a Circle whose Circumference is 1.

If the Area be given to find the Side of the Square equal, you need but extract the square Root of the Area given, and it is done. So the square Root of .7853 is .88.62, which is the Side of a Square equal when the Diameter is 1. And if you extract the square Root of .079577, it will be .2821, which is the Side of the Square equal to the Circle whose Circumference is 1.

If the Side of a Square within a Circle be required, if you square the Semidiameter, and double that Square, and out of that Sum extract the Square Root, that shall be the Side of the Square which may be inscribed in that Circle; so if the Diameter of the Circle be 1, then the Half is .5, which squared, is .25, and this doubled, is .5, whose square Root is .7071, the Side of the Square inscrib'd.

Again, if the Diameter of a Globe be 1, to find the Solidity. it is demonstrated, that the Globe is $\frac{8}{15}$ of a Cylinder of the same Diameter and Altitude. Thus, if the Cylinder's Diameter be 1, and its Altitude or Length be also 1, find the Solidity thereof, and take $\frac{8}{15}$ of it, and that will be the Solidity of the Globe required. Now if the Diameter be 1, the Area of the Circle, or Base of the Cylinder, is .7854, (as is above shewn;) which multiply'd by 1, the Altitude of the Cylinder, and the Product is also .7854, the Solidity of the Cylinder; $\frac{8}{15}$ whereof is .5236, which is the Solidity of the Globe, whose Diameter is 1.

GUTTÆ, in Architecture, are Ornaments in the Form of little Cones, used in the Platfond of the *Doric* Cornice, or on the Architrave underneath the Triglyphs, representing a sort of Drops or Bells, and usually fix in Number.

GUTTERS, in Architecture, are a kind of Valleys in the Roofs of Buildings, serving to receive and drain off the Rain Waters.

These *Gutters* are of two Kinds in respect to their Position; for they are either such as come something near a Parallelism with the Horizon, or such as incline towards a vertical Position to the Horizon.

The first Kind of *Gutters* may be called *Parallel Gutters*, and may be distinguish'd into three Sorts, which are covered with Lead: For,

First, Either it is a *Gutter* between two Roofs, which stand parallel to each other, being made upon the Feet of the Rafter of two Roofs, which meet together. Or,

Secondly, A *Gutter*, where a Building has a Cantaliver or Modillion Cornice, which projects one Foot and a half, or two Feet (according to the Design of the Building) beyond the Walls; then the Roof is set with the Feet of the Rafter no farther out than the Wall, but rather within it; so that the Joists of the upper Floor lie out beyond the Walls, and also beyond the Feet of the Rafter, which is yet cover'd with Lead.

The third Sort of these *Parallel Gutters* are in flat Roofs, which are usually called *Platform*s; where are also *Gutters* for the Water that run from the Platform to descend to, which is from thence convey'd off from the Building, either by Spouts or Pipes.

Secondly, *Vertical Gutters* are such as are made by two Roofs meeting at Right Angles one to another, or (which is the same Thing) made by the End of one Roof

Roof joining to the Side of another

As for Example: If a Building be in the Form of a *Roman L*, it is then common to have one *Gutter* on the Inside of the *L*; but if the Building be in the Form of a *T*, it has two *Gutters*; but if in the Form of an *H*, it has four.

These *Gutters* also are of two Sorts, *viz.* either of Lead or Tile: All which shall be treated of in Order.

Of the Laying of Parallel Lead Gutters.

In speaking to this Head, I shall first give a necessary Caution, which is, *viz.* first to take care that the *Gutter-Boards*, &c. lie not too near parallel with the Horizon; but in such a Position, that there may be a good Current, (as the Workmen phrase it,) for if it be laid too near a Level, the Water will be very subject to stand in Patches, if the *Gutter* chances to stick a little in the Middle, &c. which some *Gutters* are apt to do: But this is according as they are posited in the Building.

Some *Gutters* have a Layer of Sand for the Lead to lie upon; but there are two Reasons that may render this Method not approveable.

First, Because some Sorts of Sand does very much corrode and decay the Timber that lies near it.

Secondly, That when a *Gutter* is laid on Sand, but a very little squatting, *viz.* by jumping upon

it with the Heels of one's Shoes, will make Dents in it, and in those Dents the Water will stand; and this will be a Means of decaying the Lead the sooner.

In laying of Leads for *Gutters upon Boards*, 'tis common for Plumbers, to folder them, when they are so long, that a Sheet of Lead will not reach. To do this, they usually cut a Channel cross the *Gutter-Boards* at the End of the Sheet where the Soldering is to be, and to beat down the Ends of both the Sheets (that are to meet there) into the Channel; which, when it is done, there will remain a little Cavity, which is filled up by the Solder level with the rest, when it has been soldered.

The Lead which is usually laid in *Gutters* is that which weighs about eight or nine Pound to the Foot. See *LEAD*.

Of Vertical Gutters.

These *Gutters* are made either of Lead, or Tile. As to those made with Lead, I shall forbear saying any Thing, because they are almost the same in Effect as the Parallel ones. But, that unless the Builder will be at the Charge, they need not be altogether so thick for these Vertical ones, as for the Parallel ones: For these Vertical ones will last as long, if laid with Lead of about six or seven Pound to the Foot, as Parallel ones with Lead of eight, nine, or ten Pound to the Foot.

Gutters laid with Tiles, are also of two Kinds: Those made of

of *Concave* or *Gutter-Tiles*, and *Plain Tiles*. Of which I shall omit speaking here, but recommend to the Article GUTTER-TILES.

Plain Tile-Gutters are also distinguish'd into two Sorts, *viz.*

I. *Plain Tile-Gutters*, (properly so called.) And,

II. *Point-Gutters*. Of both which I shall treat in their Order.

First, *Of Plain Tile-Gutters*, (properly so called.)

In these *Plain Tile-Gutters*, there is a *Gutter-Board* laid, which raises them from pointing to an Angle. And in laying on the Tiles, the Workman begins at one Side of the *Gutter*, and so works across, as if it were plain Work, and then brings the next Row of Tiles back again; so that he works forth and back, or to and fro, from Right to Left.

So that *Gutters* which are laid after this Manner, are not angular, but of a kind of distorted curvilinear Form; by which Means they are not so subject to be furr'd up with the Mortar which washes out of the adjacent Tiles.

II. *Of Three-Point Gutters*.

These are the second Sort of *Gutters*, which are laid with plain Tiles: In laying of which they begin and lay one Tile on one Part of the Roof, (it is no Matter which Part first) and lay one Corner of the Tile just in the

Middle of the *Gutter*; and then they lay another on the other Part of the Roof, with its Corner just in the Middle of the *Gutter*, also that the Corner of the second Tile is contingent with the first; and then lay another Tile in the *Gutter*, with its Corner, as it were, betwixt the other two; and to them.

When they have done thus, they proceed in the Work, and lay a Tile on each Part of the Roof, as before, and another betwixt them in the *Gutter*, proceeding in their Work in this Manner, till they have finish'd the *Gutter*. And this is what is called a *Three-Point Gutter*: For three Points, or Angles of Tiles, always come together, *viz.* one Angle of three distinct Rules, which makes it very uniform and handsome.

Here you are to take notice, that only three Inches square of the middle Tile is visible (if the Gage be seven Inches,) the rest of that Tile being covered with the next Row of Tiles above it.

But notwithstanding these *Gutters* are very handsome, and if well done, secure also; yet if they let the Water into the House (by reason of some Stoppage, or broken Tile in the *Gutter*,) they are very troublesome to mend.

Of Measuring Gutters or Valleys.

There are usually different Customs in different Parts of the Kingdom, 'as to the measuring of *Gutters* or Valleys in Tiling: For in some Places, they but seldom,

seldom, if ever, allow any Thing for the *Gutters*; but include them in the rest of the Roof at Flat and Half. And some say, at *London*, they very seldom measure the *Gutters*, but only as they are Part of the Roof; so they are included in the Flat and Half-Measure.

Some Workmen at *Tunbridge- Wells* never demand any other, but only as it is included in the Plain Measure; which is an Area found by Multiplication of twice the Length of the Rafter by the Length of the Building; or, which is the same Thing (when it is three quarters pitch,) the Flat and Half-Flat.

In laying of *Gutters* with concave Tiles, the Workmen in some Pars of *Staffex* and *Kent*, have brought up a Custom of being allowed so many Feet more than the Plain Measure, as there are *Gutter-Tiles*, (and also including *Corner-Tiles*, *Ridge-Tiles*, and *Dorman-Tiles*,) in the whole Roof.

At some other Places, they claim so many Feet more to be added to the Plain Measure, as the *Gutters* (and also Corners) are in Length, including *Gutters* at the Sides of Dormans and Lutherns, if there be any *Dorman-Tiles* used.

In some Places, the Workmen insist upon a Custom of having double Measure allowed for *Plain-Tile* (especially, *Three-Point*) *Gutters*, e. g. if there were but one *Gutter* in a Roof, and this *Gutter* fifteen Feet long, then their Custom is to have thirty Feet more than the Area of

the Roof amounts to; and this Allowance some Workmen claim in both Sorts of *Gutters* with *Plain Tiles*.

Either of these *Plain-Tile Gutters* are cheaper to the Master-BUILDER, than Concave ones; because Plain Tiles are cheaper than *Gutter-Tiles*, they being in many Places not above one fourth Part of the Price.

And besides, if the Workmen be allow'd so many Feet more than the Area of the Roof, as there are *Gutter-Tiles* that will be one half as much more as the Double Measure; for if it be gaged so slight as eight Inches, then in a *Gutter* of fifteen Feet long, there would be forty-five Tiles, which will be reckon'd forty-five Feet; whereas at Double Measure, it amount-ed but to thirty Feet.

There is another Way of computing Double Measure; for the Account of which, I shall refer you to the Article SLATING.

GUTTERING, in Carpentry, is usually done by the Lineal Foot, which is by some valued at *London*, for Materials and Workmanship, at 1 s.

GUTTER-TILES are whilst they are flat and plain, (before they are bent fit for the Use they are intended,) seemingly at a Distance, a kind of Triangle, with one convex Side. But although they seem to be so at a Distance, they are not in Reality so; for they are of a quadrangular Form, consisting of two streight Sides, of about ten, or ten Inches and a half long, (for

G U

(for so much they ought to be,) and of two circular Sides, the one convex, the other concave; the convex Side is about fourteen Inches, and the concave one about two Inches. This is their Form as to their Edges or Sides. I shall next describe the Form of them, in respect of the Plane; at the little End they are bent circular, and so likewise at the convex great End, at first like a Corner Tile; but then they bend the Corners of the great End back again; so that if a Person look against the Edge of the broad End, it consists of a circular Line betwixt two straight ones, like the upper Part of the Character of the Sign *Libra* ♎: This, you must understand, is when you hold the concave Side of the Tile downwards.

These Tiles are laid with their broad Ends and hollow Sides upwards.

As to the Weight of Gutter-Tiles.

These Tiles, whose Dimensions were 10 Inches on the straight Edges, 14 Inches on the great convex Edge, when press'd down flat, as they were in the Mould, and two Inches at the concave Edge, and about $\frac{1}{8}$ Inch thick; 100 of them weigh about 321 or 322 Pounds, and consequently 1000 would weigh about 3210 or 3220 lb. which is near 29 C. Weight, and consequently 682 would be a Ton Weight.

As to their Price.

Mr. *Leybourn* says, that they are sold at *London* at 1d $\frac{1}{2}$ or

H A

2d. per Tile, or between 10 and 15s. per 100. In some Places their constant Price is 1d. $\frac{1}{2}$ per Piece, or 12s. per 100.

H A

HAIR, with Plaisterers, is *Bullocks Hair*, &c. which is used in white Mortar; a certain Quantity of which is put to a certain Quantity of Lime. See LIME and MORTAR.

As to the Price: This varies, according to the Plenty or Scarcity of it in *London*.

In some Places in *Kent* it has been sold for seven Pence per Bushel; and in *Sussex* for ten Pence and twelve Pence; so that a Horse-Load, which is sixty Bushels, may be from thirty Shillings to three Pounds, more or less.

HALF-ROUND. See CAPITAL.

HALL, in Architecture, is a large Room at the Entrance of a fine House, Palace, or the like.

Vitruvius mentions three Sorts of Halls: The *Tetrastyle*, which has four Columns, supporting the Plafond or Ceiling; the *Corinthian*, which has Columns all around let into the Wall, and is vaulted over; and the *Egyptian*, which had a *Peristyle* of insolated *Corinthian* Columns, bearing a second Order with a Ceiling.

The Hall is properly the first and finest Partition or Member of an Apartment; and in the Houses

H A

Houses of Ministers of State, publick Magistrates, &c. is that wherein they dispatch Business, and give Audience.

In very magnificent Buildings, where the *Hall* is larger and loftier than ordinary, and placed in the Middle of the House, it is called a *Saloon*.

Of their Dimensions.

A certain noted *French* Architect directs, that the Length of a *Hall* be at least twice and a quarter its Breadth, and that in great Buildings you may allow it three Times the Breadth; which last Length, he says, will be the most beautiful and convenient.

As to the Height of *Halls*, it may be two Thirds of the Breadth, or sixteen or eighteen Feet in noble Buildings.

In large and stately Buildings, the *Halls*, and other Rooms of the first Story, may be arched; by which Means they will be rendered much handsomer, and less subject to Fire.

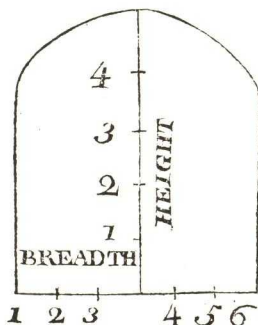
The Height is to be found by dividing the Breadth of the *Hall* into six Parts, and five of those shall limit the Height of the Room, from the Floor to the under Side of the Key of the Arch.

HALLS and **ANTICHAMBERS**, and other Rooms of the first Story that are arched, which will be much more handsome, and less subject to Fire; their Height may be adjusted by dividing the Breadth into six Parts, and taking five of them for the Height from

H A

the Floor to the Superficies, unto the Bottom of the Key of the Arch.

As for Example: Let the Figure be twenty-four Feet in Breadth, more or less, and be divided into six equal Parts; take five of them, which will be twenty Feet in Height from the Floor unto the Bottom of the Key of the Arch. See the Figure.



And if you would have it higher, you must divide the said Breadth into eight Parts, and take seven of them for the Height, which will make twenty-one Feet.

And if you divide the same Breadth into twelve Parts, take eleven of them, which will make the Height twenty-two Feet from the Floor to the Bottom of the Key of the Arch.

The Chambers of the second Story must be a sixth Part less in Height, than the Chambers below.

As if the first Story be twenty Feet in Height, divide the twenty Feet into six equal Parts, and take five of them, which will make the second Story sixteen Feet

H E

Feet eight Inches from the Floor to the Joist.

Again, if the first Story be twenty-one Feet in Height, divide the twenty-one Feet into six equal Parts; take five of them, and they will make the second Story seventeen Feet six Inches from the Height of the Floor to the Joist.

If the first Story be twenty-two Feet in Height, divide the twenty-two Feet into six equal Parts, and take five of them, which will make the second eighteen Feet four Inches in Height.

HAMMER HARDENING is mostly used on Iron and Steel Plates for Saws, &c.

TO HANG OVER. See to **BATTER.**

HANSE. See **ARCHES.**

HEAD, in Architecture, &c. is an Ornament of carved Work or Sculpture, frequently serving as the Key of an Arch, or Plat-Band on other Occasions.

These sort of *Heads* usually represent some of the Heathen Divinities, Virtues, Seasons, Ages; with their Attributes, as a Thunderbolt for *Jupiter*, a Diadem for *Juno*, a Trident for *Neptune*, a Crown of Ears of Corn for *Ceres*, a Helmet for *Mars*, a Caduceus for *Mercury*, &c.

The *Heads* of Beasts are also used in Places suitable, as an Horse's *Head* for an Equerry, a Deer's or Boar's for a Park or Forest, a Dog's for a Kennel, a Bullock's or Sheep's for a Shambles or Market-House.

In the Metopes and Friezes, and other Parts of certain *Antique Doric* Temples, we see Representations

H E

of *Bullocks* or *Rams Heads* fixed, as a Symbol of the Sacrifices offered there.

HEADS, with Bricklayers, a Term used to signify half a Tile in Length; but to the full Breadth of a Tile: These they used to lay at the Eaves of a Roof.

HEADING *Architrave.* See **ARCHITRAVE.**

HEALING, in Architecture, signifies the covering the Roof of a Building, either with Lead, Tiles, Slate, Horsham Stone, Shingles, Reeds, Straw, &c.

HEARTH Stones. See **FIRE-STONES.**

HEAT, in Smithery. See **Iron.**

HEEL, in Carpentry, an inverted Ogee.

HEIGHT is the third Dimension of a Body, considered with respect to its Elevation above the Ground.

Altimetria is an Art or Science, which teaches the Measuring of all *Height*, both accessible and inaccessible.

The Instruments chiefly used in taking *Heights*, are the Quadrant, and the Geometrical Quadrant.

HELICOID Parabola, or the *Parabolick Spiral*, is a Curve arising upon a Supposition of the Axis of the common *Apollonian Parabola's*, being bent round into the Periphery of a Circle.

The *Helicoid Parabola* then is a Line passing through the Extremities of the Ordinate, which now converse towards the Centre of the said Circle.

HELIOSCOPE, in Opticks, a Sort of Telescope peculiarly fitted for viewing and observing the

the Sun, as his Spots, Eclipses, &c.

HELIX, the Word is *Greek*, and literally signifies a Wreath, or Winding.

Helix, in Architecture, is the Caulicoles, or little Volutes under the Flower of the *Corinthian* Capital, called also *Urilla*.

Helix, in Geometry, is a Spiral Line; but some Authors in Architecture make a Difference between *Helix* and *Spiral*.

A Stair-Case, according to *Daviler*, is an *Helix*, or is *heliacal*, when the Stairs or Steps wind round a cylindrical Newel; whereas the Spiral winds round a Cone, and is continually approaching nearer and nearer its Axis.

HEMISPHERE, in Geometry, is one half of a Globe or Sphere, when divided into two, by a Plane passing through its Centre.

HEMISPHEROIDAL, in Geometry, approaching near to the Figure of a *Hemisphere*, but is not justly so.

HEPTAGON, in Geometry, a Figure consisting of seven Sides and seven Angles; which, if the Sides be all equal, is called a regular *Heptagon*.

HEPTAGONAL Numbers, are a Sort of Polygonal Numbers, wherein the Difference of the Terms of the corresponding arithmetical Progression is five.

One Property, among others of these Numbers, is, that if they be multiply'd by 40, and 9 be added to the Product, the Sum is a Square Number.

HEXAEDRON } in Geo-
HEXAHEDRON } metry,

is one of the five regular Bodies properly called a *Cube*.

HEXAGON, in Geometry, a Figure of six Sides, and as many Angles. If these Sides and Angles be equal, it is called a regular *Hexagon*.

The Side of a *Hexagon* is demonstrated to be equal to the Radius of a Circle circumscribed about the same.

Hence a regular *Hexagon* is inscribed in a Circle, by setting the Radius off six Times upon the Periphery.

HEXASTYLE, in the antient Architecture, a Building, having six Columns in Front.

HINGES, in Building, are those necessary Irons by Means of which Doors, Lids, Folds of Tables, &c. whether of Houses or other Buildings, make their Motion, whether of opening or shutting, or folding, &c.

The Sorts or Kinds are many; as *Beds, Box, Buts, Casement, Lancashire and Smooth-filed; Casting, Chest-black Lancashire, Smooth-filed Coach, Desk, Dove-Tails, Effes, Folding, Garnets, Dozen-Ware long, Dozen-Ware short, Weighty long, Weighty short, Lambs-Heads, Port-Side Lancashire, Side Smooth-filed, and Smooth-filed, Side with Squares, Side with rising Joints, Lancashire and Smooth-filed Stall; Trunk of sundry Sorts; Screw, Scuttle, Shutter, Lancashire Joints, Lancashire Dozen-Ware with Hooks, Dozen-Ware long, Dozen-Ware short, Weighty long, Weighty short.*

The Price of some of these
Hinges are as follows:

Bed-Hinges, from 5 s. to 7 s. per
Dozen.

Box-Hinges, from 1 s. to 4 s. per
Doz.

Small Brass ones, from 2 s. to
2 s. 6 d. per Doz.

Dove-Tails, from 1 s. to 4 s. per
Doz.

Hooks and Hinges, &c. per lb.
from 3 d. $\frac{1}{4}$ to 4 d.

Side-Hinges, from 3 s. to 16 s.
per Doz.

With a Square, from 20 s. to
36 s. per Doz.

Screw-Hinges, from 30 s. to 48 s.
per Doz.

HIPS, in Carpentry, are those
Pieces of Timber which are
placed at the Corner of a Roof.

The *Hips* are much longer
than the *Rafters*, by reason of
their oblique Position; and are
planted not with a right or square
Angle, but a very oblique one;
and consequently are not, or at
least ought not to be square at
any Angle, as *Rafters* are not at
all, but level at every one of
them; and which is yet more, as
Rafters have but four Planes,

these commonly have five. They
are commonly, by Country Work-
men, called *Corners*, and some
call them *principal Rafters*, and
others *Sleepers*.

The Truth is, *Hips* and *Sleepers*
are much the same, only the
Sleepers lie in the Valleys, (and
join at the Top with the *Hips*;)
but those Surfaces or Planes
which make the Back of the
Hip, are the under Sides of the
Sleeper.

The Backs of a *Hip* are those
two Superficies or Planes on the
Outside of the *Hip*, which lie
parallel, both in respect of the
Length and Breadth with the Su-
perficies of the adjoining Side,
and End of the Roof.

Hip-Mould is by some used
for the Back of the *Hip*: But
others understand it to mean the
Prototype, or Pattern, common-
ly made of a thin Piece of Wain-
scot, by which the Back and Sides
of the *Hip* are set out.

I shall here give you the Me-
thod of finding the Length and
Backs of *Hips*, &c. in square
Frames, and also of the *Rafters*,
Diagonals, Half Diagonal, and
Perpendicular, as follows:

$$\begin{array}{l} \text{Feet.} \\ \text{As } 20 \left\{ \begin{array}{l} 15 : 00 \\ 18 : 09 \\ 11 : 18 \\ 28 : 20 \\ 16 : 63 \end{array} \right\} :: \text{Breadth of the House : } \left\{ \begin{array}{l} \text{ten of the Rafter.} \\ \text{ten of the Hip.} \\ \text{Perpendicular.} \\ \text{Diagonal.} \\ \text{nearest Distance.} \end{array} \right. \end{array}$$

$$\text{Hip Angles } \left\{ \begin{array}{l} \text{at Foot } 38-22 \\ \text{at Top } 51-28 \\ \text{at Back } 116-12 \end{array} \right\} \text{Rafter Angles } \left\{ \begin{array}{l} \text{at Top } 41-50 \\ \text{at Foot } 48-10 \end{array} \right.$$

The Angles are always the same in all square Frames that
are true Pitch.

Hip

Hip-Roof, with Carpenters, called also *Italian Roof*, is a *Roof* which has neither *Gable-Head*, *Shread-Head*, nor *Jerkin-Head*; (by which is meant such Heads as are both *Gable* and *Hip* at the same End :) For 'tis a *Gable* or Upright as high as the Collar Beam; and then there are two short *Hips*, which shut up with their Tops to the Tops of a Pair of Rafters, which Country Carpenters call *Sizglars*.

For a *Hip-Roof* hath Rafters as long, and with the Angles at the Foot, &c. at the Ends of Buildings, as it has at the Sides; and the Feet of the Rafters on the Ends of such Buildings as have *Hip-Roofs*, stand on the same Plane, viz. parallel with the Horizon, and at the same Height from the Foundation with Rafters on the Sides of the *Roof*.

These are the *Hip-Roofs* that are by some called *Italian Roofs*.

The Method of Measuring Hip-Roofs.

If they are three quarters, or true Pitch, as it is commonly called, then it is only multiplying the Length of the Building by the Breadth, and adding half as much more to the Area found; or else multiplying the Length by the Breadth and half, or the Breadth by the Length and half: Either of these three Ways will produce the Flat and half, which is equal to the Content of the *Roof* in plain Measure, if nothing be allowed for *Hips* and *Valleys*; but if the *Roof* have no Cornice, but the Rafters have Feet, then they must be added;

VOL. I.

and also the Eaves-Board, in a Bill of Measurement.

Or you may measure such a *Roof*, by multiplying the Length of it by the Length of the Rafter, and it will give the Half Content; or else by multiplying the Length of the Building by twice the Length of the Rafter; which will give the whole Content.

How to find the Curve-Lengths and Backs of the Hip, either bevel or square of Roofs in general, observe the following Examples. See Plate XII.

The Figure I. is an *Hexagon Plan*, and an *Ogee Rafter*.

First, Draw the Plan *abcdef*, also draw the Line *bb*; then divide the Line *ab* in the Middle at *i*, and draw the Line *ib*; then will *bb* be the Base of the *Hip*, and *ib* the Base of the Rafter: From *b* draw a Line to *k*, perpendicular to *ib*, and equal in Length to the Perpendicular of the Rafter; also from *b* draw a Line to *g*, perpendicular to *bb*, and equal to *bk*; then draw the moulding Part of the Rafter *ik* in what Form you please: Having so done, divide the Line *ib* any how; from which Divisions raise perpendicular Lines to touch the Curve Line *ik*; continue those Lines to touch the Line *bb*, as the dotted Lines in the Example shew, which will divide the Line *bb* into the same Number of Parts and Proportion with the Line *ib*; then from those Divisions raise perpendicular Lines at Pleasure, and take the perpendicular Line *1, 1*, on the Line *ib*, to the Curve of
G g the

the Rafter *ik* in your Compasses, and set it up the correspondent perpendicular Line on the Line *bb*, as 1, 1; also the Line 2, 2; and 3, 3; and so of all the rest: And in each of these Points stick a Nail, and bend a thin Lath round, to touch them all at once; then on the Edge of it draw the Curve of the Hip *gb*; which was to be done.

This Fig. II. represents the Hip bg in Fig. I. and 1, 2, 3, 4, at the Point e, represents the Sole of the Foot of the Hip, before the Back is work'd.

First, Draw the Lines on the Hip, at any convenient Distance, parallel to the Foot of the Base *ac*; then draw the Sole of the Foot of the Hip, as 1, 2, 3, 4, at the Point *e*, of the preceding Figure, Number I. and take in your Compasses the Distance between the Point 1 to the Line *ef*, or from 2 to the Line *ed*, and set it from the Back of the Hip *ab* on those parallel Lines which you see marked by Dots; then strike a Nail into each of these Dots or Points, and bend a thin Lath to touch them all at once, and on the Edge of it strike a Curve Line; then draw a middle Line down the Back of the Hip, and between that Line and the Curve, which is created by these Dots, hew off the superfluous Wood, which will make the true Back of the Hip; and so of all other Roofs, in what Form soever: But only you must observe, if your Plan is bevel, as one End of *g*, to set the Superfluity of the Sole of the Hip at the Point *c*, which is from

3 to the Line *cb*, and from 4 to the Line *cd*, on their proper Sides of the Hip, because one Side will be wider than the other, which is the Case on the Back of all bevel Hips.

The Plan *abcdef*, in Fig. III. is a Hexagon, the same as Fig. I. and the Lines *bb*, *gb*, *bk*, and *bi* in the one, is equal to *bb*, *ib*, *bg*, and *bk* in the other; so also are the Soles of the Feet of the Hips 1, 2, 3, 4, at the two Points *e*; and there is no other Difference than the Curves of the Rafter, and, of consequence, needs no other Explanation; and so likewise of the two Hips, Fig. II. and Fig. IV. the two last Figures being laid down only for Variety sake.

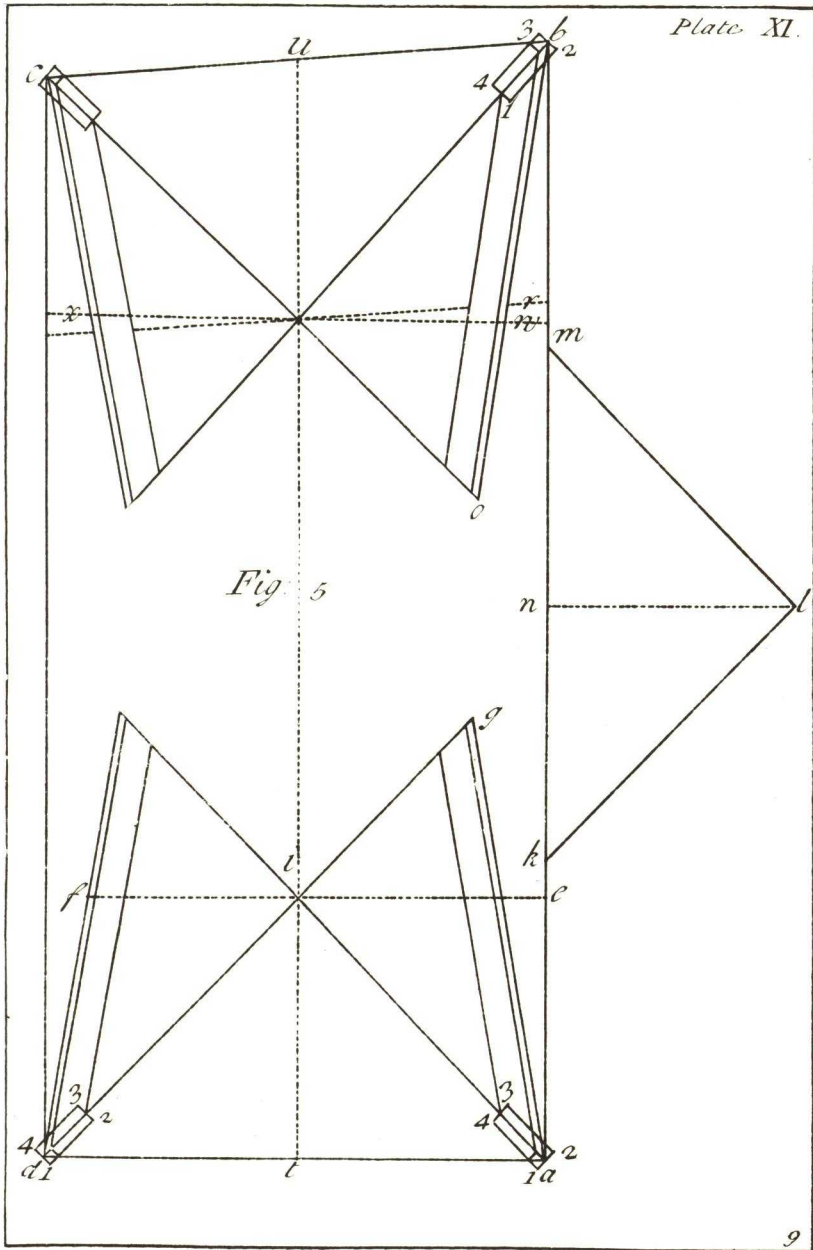
How to find the Length and Bevel, and the Mould for a Hip, either bevel or square, whether it be above Pitch, or under Pitch. Plate XIII.

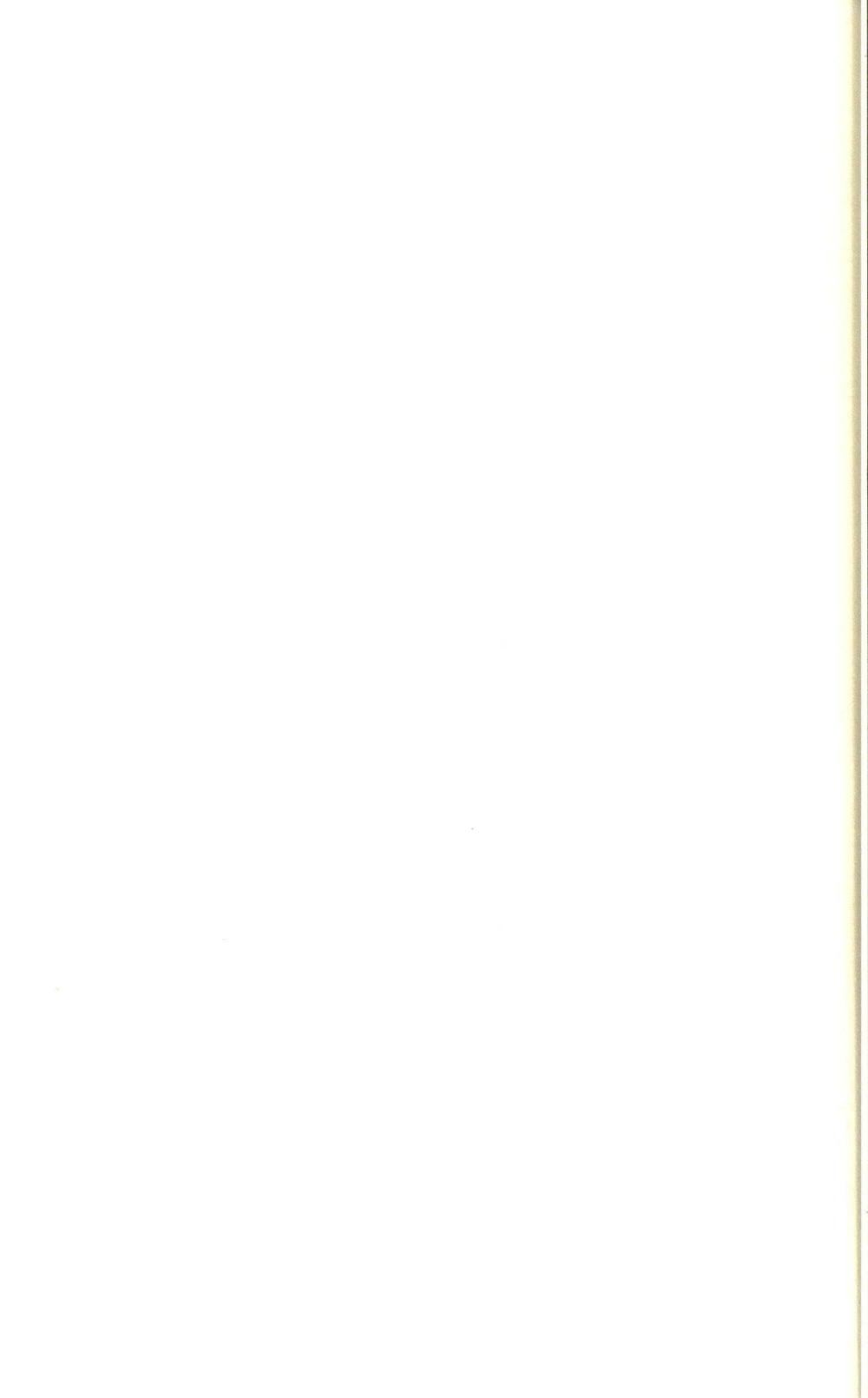
First, Draw the Plan *abcd*, and let one End be bevel, as *bc*, and the other End square, as *ad*, which divide in the Middle by the dotted Line *tv*.

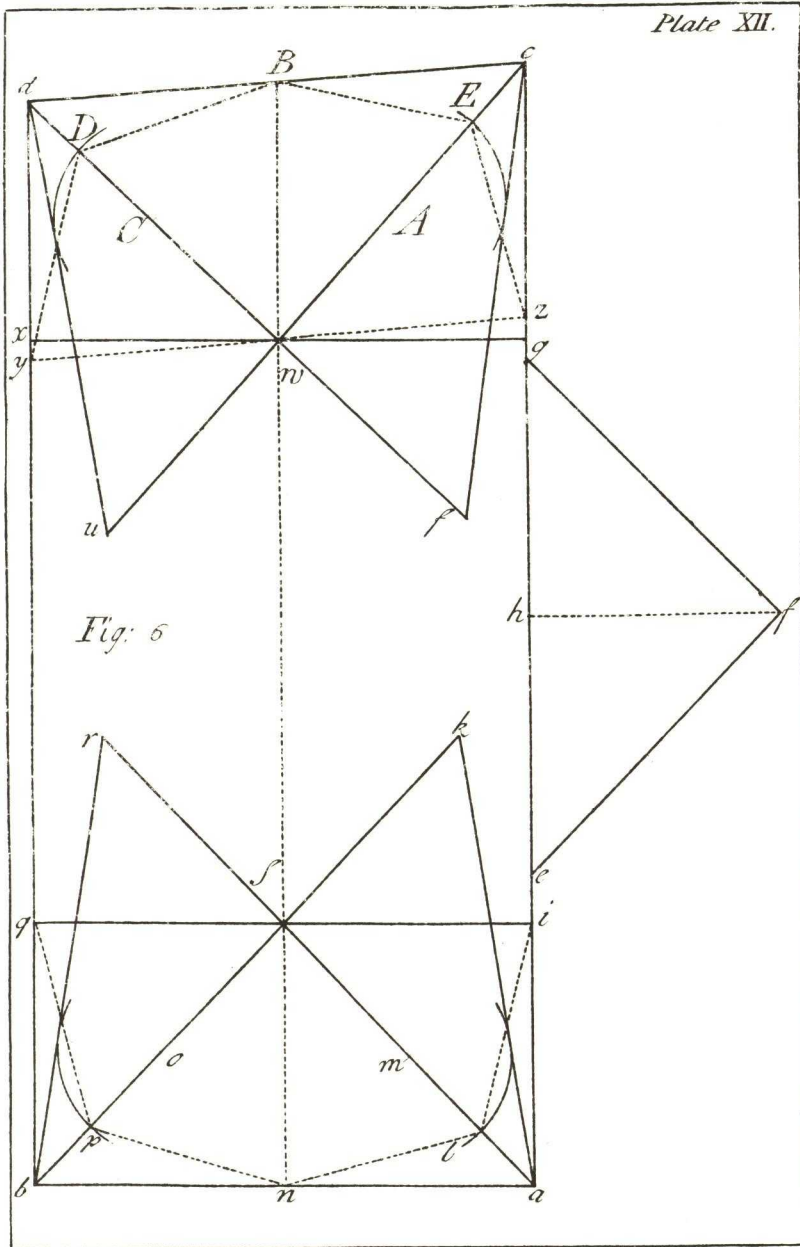
Then draw the Line *ef* parallel to *ad*, and distant as far as *at* or *td*, and draw the Lines *ia* and *id*.

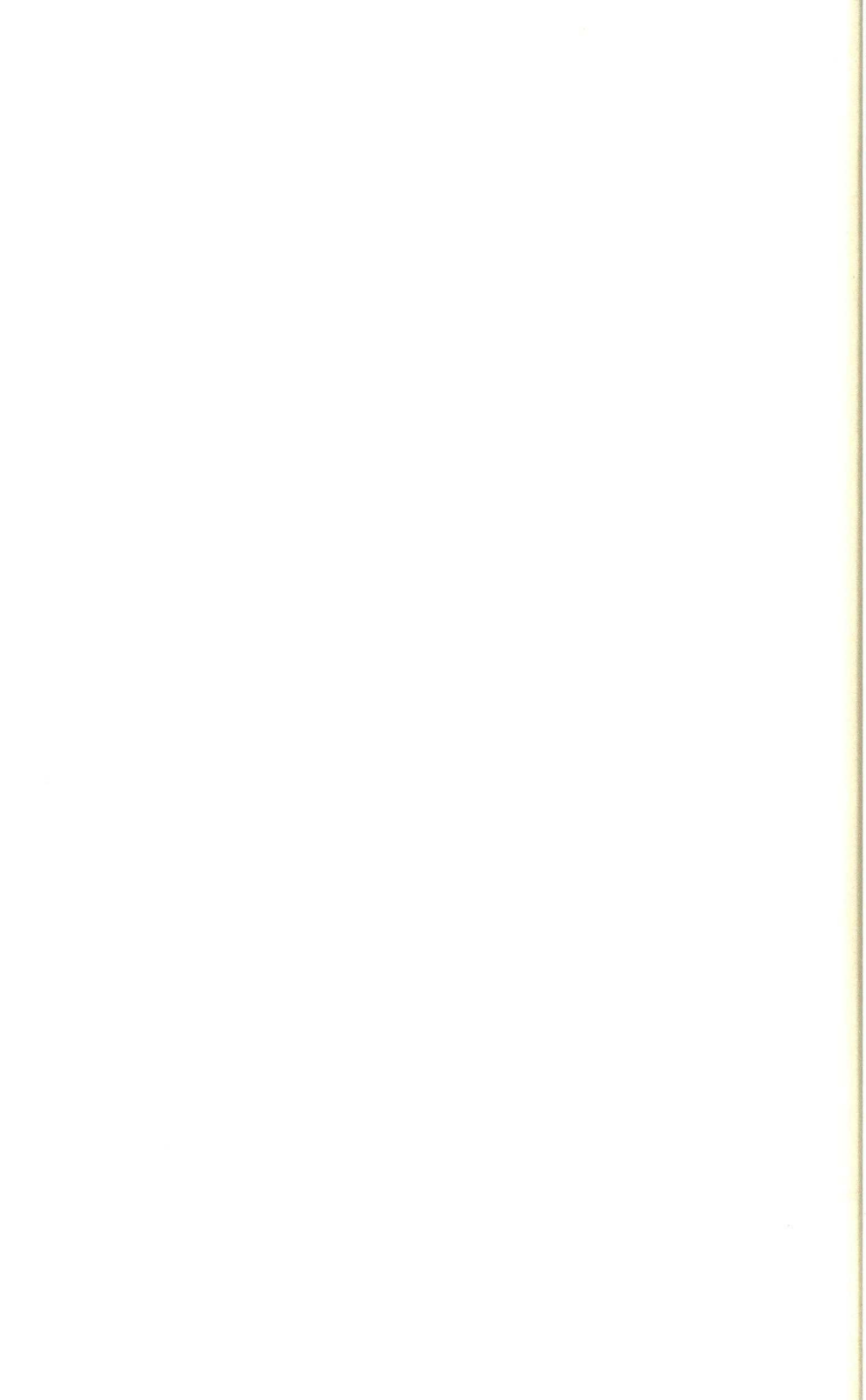
Then take the Line *ad* in your Compasses, and set it on the Line *ab*, as *km*, and draw the Lines *kl* and *ml*, to represent the Pitch of the Rafter, and let fall the Perpendicular *ln*; which take in your Compasses, and set it from *i* to *g*, and from *i* to *h*, in a straight Line with *id* and *ia*, and draw the Lines *ga* and *bd*.

Then









Then draw the Line rs parallel to bc , and distant so much as ei or it .

Then draw the Line wx through the Point p , and parallel to ef , and draw the Lines bp and cp .

Then take the Perpendicular ln , and set it from p to o , and from p to q , in Right Lines with bp and cp , and draw the Lines bo and cq .

Then is bo , cq , dh , and ag , the Length of the four Hips.

And if the Lines po and pq were raised up, they would meet perpendicular over the Point p ; so would the Lines ig and ib meet over the Point i ; then draw the Breadth of the Hip parallel to the Line ag .

To find the Back of the Hip.

Set its Splay or Foot in its Position on its proper Place; the Sole of which is represented by its proper Figures 1, 2, 3, 4, in this Example; and strike it by on the under Side or Sole of the Hip to the Line ab and ad , which will shew you how much of it hangs over the Plates ad and ab , as from 1 to the Line ad , and from 1 to the Line ab at the Angle a , and from the Extremity of those Strokes, strike a Line on each Side the Hip parallel to the Back or Line ag .

Then strike another Line on the Middle of the Back, and those three Lines give its true Bevels, to answer both Sides of the Roof, whether it be bevel or square, by hewing off the superfluous Wood between Line and Line.

N. B. If you do not approve of setting the Hip up in its Position, you may find its Back by drawing a Line on the Angle of your Plate, as ai ; also a middle Line on the Sole of the Foot of the Hip; and take the Bevels from the Line ia and b , and ia and d , and set them on the Foot or Underside of the Splay, which will be of the same Effect, as setting it up in its Position.

To find the Length of the Hip, and Mould for its Back, an other Way. Plate XIV.

Draw the Plan $acdb$, and divide it in the Middle by bn , and draw the Line iq parallel to ab , and equal to an or nb ; also the Line zy parallel to cd , and distant equal to ai ; then draw the Line gx through the Point w , parallel to iq ; and draw the Lines cd , dw , af , and bf .

Having done this, take the Width of the Span ab , and set it on the Line ac any where, as eg , and draw the Lines for the Pitch of the Rafter ef and gf ; also the Perpendicular Line fb , which take in your Compasses, and set it from w to t , and from w to u , in a straight Line with cw and dw ; also from s to k , and from s to r , in a straight Line with sa and sb ; and draw the Lines for the Length of the Hips ct , du , ak , and br .

To draw the Lines for the Mould for the Back of the Hip.

Lay a straight Rule from i to n , and make the Point m from

G g 2

n,

n to *q*, and make the Point *o*; also from *z* to *b* make the Point *a*, and from *b* to *y* make the Point *c*; then take the Compasses, and set one Foot in the Point *m*, and move the other Foot, till it touches the nearest Place of the *Hip-Line ak*; which move about and make the Point *l*, and draw the Lines *il* and *ln*, then is *iln* the Mould for the Back of the *Hip ak*; also *npq* for the *Hip br*.

The same Method is used for the *Bevel-Hips ydb*, as is for the Back of the *Hip du*, and *bez* for the *Hip ct*; which was to be done. See Plate XIV.

HIP-TILES. See CORNER-TILES.

HOLLOW, in Architecture, a concave Moulding about a Quadrant of a Circle, by some called *Casement*, by others *Abacus*.

HOLLY. The Timber of *Holly* is the whitest of all hard Wood, and therefore used by the Inlayers. It is also fit for all sturdy Uses; the Mill-Wright, Turner, and Engraver, prefer it to all others. It makes the best Handles and Stocks for Tools, Flails, Carters Whips, Bowls, Shivers, and Pins for Blocks. It is excellent for Door-Bars, &c.

HOMOLOGOUS, in Geometry, is apply'd to the Sides of similar Figures, which are said to be *Homologous*, or in Proportion the one to the other. Thus the Base of one Triangle is *Homologous* to the Base of another similar Triangle, so in similar Triangles, the Sides opposite to equal Angles, are said to be *Homologous*.

HOOKS, in Building, are a necessary Sort of Utensils which are useful for several Purposes. They are of various Sorts, some of Iron, and others of Brass: Some of the Names of which are as follows:

1. *Armour-Hooks.* These are generally of Brass, and are to lay up Arms upon, as Guns, Muskets, Halberts, Half-Pikes, Pikes, Javelins, &c.

2. *Casement-Hooks.*

3. *Chimney-Hooks*, which are made both of Brass and Iron, and of different Fashions. Their Use is to set the Tongs, Fire-Shovel, &c. against. These are sold from 2s. to 2s. 6d. a Pair; the Iron ones from 1s. to 1s. 6d. a Pair.

4. *Curtain-Hooks.*

5. *Hooks for Doors, Gates, &c.* These are from 3d. $\frac{1}{2}$ to 4d. a Pound.

6. *Double Line-Hooks*, large and small.

7. *Single Line-Hooks*, large and small.

8. *Tenter-Hooks*, of various Sorts, viz. 2d. 3d. 4d. 6d. 10d. 20d. and 40d.

HORSHAM STONE, is a Kind of thin broad Slate, of a greyish Colour, formerly much used, especially in *Sussex*, to heal or cover Churches and Chancels, great Houses, &c.

It is called *Horsbam-Stone* in that County, because it is chiefly brought from the Town called *Horsbam*.

This Sort of Stone, or rather Slate, is laid of different Sizes, viz.

viz. from eight or nine Inches to twenty-four Inches, or more, in Length and Breadth, &c. It is commonly from half an Inch, to an Inch thick.

Of the Price.

The Value of these Stones is according to the Distance from the Quarry, *viz.* from 10*s.* to 20*s.* the Load. Some of them have been laid down for 17*s.* or 18*s.* at eighteen or twenty Miles Distance from the Quarry.

A Load of these will cover about three Fourths of a Square.

Of the Price of Laying.

The Price of laying a Square, and Pointing (which is striking Mortar under the lower Ends) in new Work, is about 5 or 6*s.*

But to rip it from old, and new lay and point it, is worth not less than 6 or 7*s.* per Square.

Of the Weight of this Sort of Healing.

A Square of this kind of Covering has been found to weigh about thirty-three or thirty-four hundred Weight; whereas a Square of Tiling does not weigh above sixteen or seventeen hundred Weight, or not above eighteen hundred Weight, though it be gaged at six Inches, and the Tiles not exceeding the Length of ten Inches.

Of the Properties of this Sort of Covering.

It will appear by what has been already said, that this Covering is dearer than Tiling; for the Charge of a Square of Tiling is from 23*s.* to 30*s.* or, as some say, from 24*s.* to 28*s.* a Square; whereas a Square of Covering with *Horsbam-Stone* will be worth from 32*s.* to 38*s.*

And, besides, for this Sort of Covering, the Timber for the Roof ought to be considerably stouter and stronger; because a Square of this Sort of Stone is almost as heavy again as a Square of Tiling.

But then these Sorts of Stones are chosen as fitter for Churches, and other strong Buildings; because they are far more durable than Tiles, they being for the most part very hard, so that no Weather will hurt them, as it will Tiles.

HOUSE, a Habitation or Place built with Conveniencies for dwelling in; or it is a Building wherein to shelter a Man's Person and Goods from the Inclemencies of the Weather, and the Injuries of ill-disposed Persons.

In treating on this Article HOUSE, I shall do these four Things:

- I. Discourse concerning the Situation of a *Country-House*.
- II. Of the Ground-Work of *Houses*.
- III. Concerning Building in *London*.
- IV. Of Party Walls,

A *Country House*, or *Pleasure House*, is one built for a Person to enjoy and divert himself occasionally in.

This is the *Villa* of the ancient *Romans*; and what in *Spain* and *Portugal* they call *Quinta*; in *Provence*, *Cassine*; in some other Parts of *France*, *Closerie*; and in *Italy*, *Vigna*.

Of the Site of a Country-House.

It is a Thing principally to be aim'd at in the Site or Situation of a *Country House* or *Seat*, that it have Wood and Water near it, they being principal Accommodations to a Rural Seat. If it cannot be conveniently built among Trees, yet there are but few Places where Trees may not be speedily raised about it.

It is far better to have a *House* defended by Trees than Hills; for Trees yield a cooling, refreshing, sweet, and healthy Air, and Shade during the Heat of Summer, and very much break the cold Winds and Tempests from every Coast in the Winter.

The Hills, according as they are situated, defend only from some certain Winds; and if they are on the North Side of the House, as they defend from the cold Air in the Winter, so they also deprive you of the cool refreshing Breezes, which are commonly blown from thence in the Summer.

And if Hills be situated on the South Side, it also then proves very inconvenient.

Besides, they yield not the Pleasures and Contentments, nor the Varieties of Delights to the ingenious Rustick, as the tall Plumps of Trees, and pleasant Groves do.

Yet Hills which are cloath'd with Coppices, or otherwise improv'd, are pleasant Objects of Sight, if they stand not too near a *House*.

A *House* should not be too low seated, since this would cause you to lose the Convenience of Cellars: But if you cannot avoid building on low Grounds, set the first Floor above the Ground the higher, to supply what you want to sink in your Cellar in the Ground; for in such low and moist Grounds, it conduces much to the Dryness and Healthiness of the Air to have Cellars under the House, so that the Floors be good, and ceiled underneath.

Mr. *Worlidge* says, that Houses built too high in Places obvious to the Winds, and not defended by Hills or Trees, require more Materials to build them, and also more Reparations to maintain them, and are not so commodious to the Inhabitants, as the lower-built Houses; which may be built at a much easier Rate, and also as compleat and beautiful as the other.

Of the Ground-Work of Houses.

In *Buildings* or *Houses* not above two Stories with the Ground Room, and not exceeding twenty Feet to the Raïson-Place,

Place, and upon a good Foundation, the Length of two Bricks, or eighteen Inches, for the Heading Course, will be sufficient for the Ground-Work of any common Structure; and six or seven Courses above the Earth to a Water-Table; where the Thickness of the Walls are abated or taken in on either Side the Thickness of a Brick, namely, two Inches and a quarter.

But for large and high *Houses* or *Buildings* of three, four, or five Stories with the Garrets, the Walls of such Edifices ought to be, from the Foundation to the first Water-Table, three Heading Courses of Bricks, or twenty-eight Inches at least; and at every Story a Water-Table or Taking-in, on the Inside, for the Summers, Girders, and Joists to rest upon, laid into the Middle, or one quarter of the Wall at least for the better Bond.

But as for the innermost or Partition-Wall, half a Brick will be of a sufficient Thickness; and for the upper Stories, a Nine-Inch (or Brick-Length) Wall will suffice.

The Parts, Proportions, &c. of the *Houses* in *London* are regulated by a Statute made for rebuilding the City after the Fire, what here follows, is so much of the Act as relates to the Bricklayers Work, the Heights and Number of Stories, and Thickness of Walls, of the four several Rates of Houses, which is as follows:

And be it farther enacted, That the *Houses* of the first and least Sort of Building, fronting by

Streets or Lanes, shall be two Stories high, besides Cellars and Garrets; that the Cellars thereof be six Feet and a half high, if the Springs of Water hinder not, and the first Story being nine Feet high from the Floor to the Ceiling, and the second Story as much: That all the Walls in Front and Rear, as high as the first Story, be of the full Thickness of the Length of two Bricks; and thence upwards to the Garrets, of the Thickness of one Brick and a half; and that the Thickness of Garret-Walls on the back Part be left to the Discretion of the Builder, so that the same be not less than one Brick Length; and that the Thickness of the Party-Wall in the Garret be of the Thickness of the Length of one Brick at least.

And be it farther enacted, That the *Houses* of the second Sort of Building, fronting Streets, and Lanes of Note, and the River of *Thames*, shall consist of three Stories high, besides Cellars and Garrets; that the Cellars thereof be six Feet and a half high, (if the Springs hinder not,) that the first Story contain full ten Feet in Height from the Floor to the Ceiling; the second full ten Feet; the third nine Feet; that all the said Walls in Front and Rear, as high as the first Story, be two Bricks and a half thick; and from thence upward, to the Garret-Floor, of one Brick and an half thick; and the Thickness of the Garret-Walls on the back Part be left to the Discretion of the Builder, so that the same be not less than one Brick thick:

And also that the Thickness of the Party-Walls between every *House* of this second and larger Sort of Building, be two Bricks thick, as high as the first Story; and thence upwards to the Garrets of the Thickness of one Brick and a half. Also that the *Houses* of the third Sort of Building fronting the high and principal Streets, shall consist of four Stories high, besides Cellars and Garrets, as aforesaid; that the first Story contain full ten Feet in Height from the Floor to the Ceiling; the second ten Feet and a half; and the third nine Feet; the fourth eight Feet and a half. That all the said Walls in Front and Rear as high as the first Story, be two Bricks and a half in Thickness; and from thence upwards to the Garret-Floor of the Thickness of one Brick and an half: That the Thickness of the Garret-Walls on the back Part be left to the Discretion of the Builder, so as the same be not less than one Brick.

And also that the Party-Walls between every *House* of this third and larger Sort of Building be two Bricks thick as high as the first Floor, and thence upwards to the Garret-Floor, the Thickness of a Brick and half.

And be it further enacted, That in all *Houses* of the fourth Sort of Building, being *Mansion Houses*, and of the greatest Bigness, not fronting upon any of the Streets or Lanes, as aforesaid, the Number of Stories, and the Height thereof shall be left to

the Discretion of the Builder, so as he exceeds not five Stories.

The same Act also enjoins, That no Timber be laid within twelve Inches of the Chimney Jaumbs; and that all Joists on the Back of any Chimney be laid with a Trimmer at six Inches distant from the Back: Also that no Timber be laid within the Funnel of any Chimney, upon Penalty to the Workman for every Default 10s and 10s. every Week it continues unreform'd.

Thus far the Act.

Note further, When you lay any Timber or Brick-Work as Tassels (or Torsels) for Mantle-Trees to lie on, or Lintels over Windows, or Templets under Girders, or any other Timbers, they must be laid in Loam, which is a great Preserver of Timber; whereas Mortar eats and corrodes it. Likewise the Joists Ends and Girders, which lie in Walls, must be loam'd all over, to preserve them from the Corroding of the Mortar.

Some Workmen pitch the Ends of Timber that lie in Walls, to preserve them from the Mortar.

Concerning Party-Walls.

In treating of these, I will present the Reader with two different Methods of valuing such Walls, according to two different Surveyors, viz. Mr. *Leybourn* and Mr. *Philips*.

And

And first, according to Mr. *Leybourn*.

He says, forasmuch as the Buildings of *London* join one upon another, and almost every several *House* hath a distinct Proprietor, the Parliament hath decreed, That the Wall dividing the Proprietors Ground shall be built at the equal Charge of both the Owners: It will not therefore be unnecessary to shew how these Party-Walls are to be valued.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
Now 4500 Bricks; at 16 <i>s.</i> per 1000, is	3	12	0
A Hundred and quarter of Lime, at 10 <i>s.</i> per Hund.	0	12	6
Two Loads and a half of Sand, at 3 <i>s.</i> per Load	0	7	6
In all	4	12	6

And thus much will a Rod of Party-Wall (the Materials only reduced to a Brick and a half thick) amount to, at the former supposed Rates; to which may be added, for Workmanship, 1*l.* 8*s.* which added to 4*l.* 12*s.* will make 6*l.*

So that for every Rod of Party-Wall, they allow 3*l.* a-piece. Whence, if a Party-Wall be measured, and the Measure, when reduced to a Brick and half, be found to contain 16 Rods, that 16 Rods multiply'd by 3*l.* will give 48*l.* and so much is the one Proprietor to allow the other.

But here you are to note by the Way, That although this Rule here delivered be general, yet the Price of the Party-Wall will be more or less, according as Materials shall be cheaper or dearer; for sometimes a Rod or Wall of Brick-Work, of a Brick and a half thick, will cost but 5*l.* 10*s.* and then each Proprie-

tor must pay but 2*l.* 15*s.* per Rod.

Thus far Mr. *Leybourn*. I shall next add Mr. *Philips's* Way. Now (says he) having the Dimensions, both in Length and Height, of the Cellar, and all other Stories in the *House*, then the following Tables will shew (according to the Thickness of the Wall) how many Bricks your Neighbour is to pay for towards his Party-Wall.

	<i>l.</i>	<i>s.</i>	<i>d.</i>
Now 4500 Bricks; at 16 <i>s.</i> per 1000, is	3	12	0
A Hundred and quarter of Lime, at 10 <i>s.</i> per Hund.	0	12	6
Two Loads and a half of Sand, at 3 <i>s.</i> per Load	0	7	6
In all	4	12	6

For which Purpose, the ensuing Tables will serve very well; for those Walls, according to the Act of Parliament for that Purpose, are to be made Part of them two Bricks thick, Part of them one Brick and half thick, and Part of them one Brick thick.

Now knowing the Number of Bricks which go to the making of the Wall, you may easily compute the Charge of the Mortar and Workmanship thereof, and from thence find the whole Charge;

Now knowing the Number of Bricks which go to the making of the Wall, you may easily compute the Charge of the Mortar and Workmanship thereof, and from thence find the whole Charge;

Now knowing the Number of Bricks which go to the making of the Wall, you may easily compute the Charge of the Mortar and Workmanship thereof, and from thence find the whole Charge;

Charge; which you will find (says he) about 30 s. for every 1000 of Bricks.

This Computation of Mr. *Phillips's* being made when Bricks were about 18 or 20 s. *per* 1000, makes his Price too great; which if they be less, may not amount to but about 25 or 26 s. *per* 1000.

He proceeds to an Example; as suppose a *House* of the third Rate, the Party-Wall of which being 30 Feet long, and you would know how many Bricks are to be paid for towards this Party-Wall.

First, Measure the Cellar, where the Party-Wall is to be two Bricks thick, the Length of which is 30 Feet, and the Depth 7 Feet; find this Length in the first Column, and the Depth in the Top of the Table; and in the Square of Meeting in the Table for one Brick thick, you will find 2314 Bricks are to be paid for.

Then proceed to the first Story, which will be likewise 30 Feet long, and 10 Feet high, and also two Bricks thick, the same Table shews the Allowance for this, which is 3306.

The second Story also is 30 Feet long, and $10\frac{1}{2}$ high; but the Party-Wall is to be but a Brick and a half thick, the Half whereof is three Fourths of a Brick, yields for 30 Feet long, and 10 Feet high, 2479.

And for half a Foot more in Height 124.

The third Story is 30 Feet long, and 9 Feet high, being likewise a Brick and half thick; and for this the Table shews the Half to be paid for to be 2231.

The fourth Story is 30 Feet long, and 8 Feet and a half high, for the 8 Feet the Table shews 1983: And for the half Foot 124.

All which added together, make 12559, which are to be paid for the half of the Party-Wall; which, at 26 s. *per* Thousand, comes to 16 l. 6 s. 6 d.

Thus you may see what any Party-Wall comes to, though your Neighbour's *House* joins never so little or much to yours, as readily as you can by measuring by the Rod.

And whereas the Floors of the several Stories add somewhat to the Height, you may add something for them, according as you find them in Thickness.

Lastly, For the Garrets; the Walls of which being but one Brick thick, you may take half the Number in the Table of one Brick's Thickness, and add to the rest of the Account.

All the Difference that can be between Neighbours herein, will be about the Price of Bricks, and the Lime and Workmanship; but if Neighbours build together, they will easily determine it: But if they do not, yet the first Builder is sufficiently provided by his Workmen to rectify his Charge, and by Act of Parliament is allowed full Satisfaction, with Interest from the Time of Building.

By a Statute made in 22 *Car. II. cap. 11. it is enacted*, That no Builders shall lay Foundations, until that proper Surveyors (appointed by the Lord Mayor of the City of *London*, Aldermen, and Common-Council,) have viewed

viewed the same, and seen the Party-Walls and Piers equally set out.

But before such Survey is taken, the Builders shall go to the Chamberlain, and enter their Names, and the Places where their Buildings are to be erected; and at the same Time pay 6*s.* 8*d.* taking an Acquittance for the same: And upon the Builders exhibiting the said Receipt unto the proper Surveyors, or any of them, they shall survey and set out the Foundation within three Days after such Request: And in default of Payment, the Chamberlain may sue for it before the Mayor and Aldermen.

As to Party-Walls: The better to prevent Fire from having a free Passage from *House* to *House*, it is enacted by *Stat. 19 Car. II.* That between every two *Houses* there shall be one Party-Wall of Brick or Stone, and of such Thickness as hereafter mentioned.

And to prevent Disputes between Landlord and Landlord, in respect to the Expences thereof, *it is hereby enacted,* That there shall be Party-Walls and Party-Piers, set out equally on each Builder's Ground; and whoever first builds his *House*, shall be obliged to leave a convenient Tothing in the Extremes of his Front and Rear Walls, that when his Neighbour, or Neighbours, is, or are disposed to build up his or their *House*, or *Houses*, the Walls of them may be incorporated, and firmly bound together.

Nor shall the second Person build against the said Party Walls, or on their own contiguous

Grounds, until they have paid the first Builder the Moiety of the Charge of such Party-Walls, with Interest at 6*per Cent.* from the Beginning of first building: And provided that any Differences arise concerning the Value of such Walls, they shall be referred to the Alderman of the Ward and his Deputy; and where one of them is a Party, or where they cannot compose such Difference, the Lord Mayor and Court of Aldermen shall.

But by an Act made in the 7th Year of Queen *Anne*, intituled, *An Act for the better preventing of Mischiefs that happen by Fires*, it is enacted, That the first Builder shall be paid by the Owner of the next *House*, after the Rate of 5*l.* per Rod, as soon as he shall have built the said Party-Wall.

And in Consideration that divers new *Houses* have been, and may be erected singly on new Foundations, within the Limits of the Cities of *London* and *Westminster*, or other Parishes or Places compriz'd within the Bills of Mortality, there was an Act made in the 11th Year of King *George I.* intituled, *An Act for the better regulating of Buildings*; which strictly forbids all second Builder or Builders, whomsoever, to make use of, or take the Benefit of such Party-Wall and Fence-Wall so first built, at the Expence of the first Builder; nor shall any such second Builder or Builders, his, her, or their Executors, Administrators, or Assigns, on any Account whatsoever, lay any Wood, or Timber, or cut any Hole for Cup-Boards, Presses,

Presses, &c. in such Party-Wall, under the Penalty of forfeiting the Sum of 50 l.

The Thickness of Party-Walls, by 19 Car. II. were appointed to consist of one Brick and half in the Cellars; and Stories above Ground, the Garrets excepted, which were to be of one Brick, or nine Inches Thickness only.

But by the Acts made in the 6th and 7th of Queen Anne, it is enacted, That from and after the first of May 1708, all and every House and Houses, that shall be built or erected upon any Foundations, either new or old, with the above Limits, shall have Party-Walls between House and House, wholly of Stone or Brick, and of the Thickness of two Bricks Length at least in the Cellar and Ground Stories, and one Brick and a half, or 13 Inches upwards, from thence quite through all the remaining Stories, unto 18 Inches above the Roof.

And to prevent the ill Consequences that may arise from Wood or Timber laid in Party-Walls, which may communicate Fire from one House into the next, it is enacted by the aforesaid Act, of the 11th of King George I. That it shall not be lawful to make or have in any Party-Wall of any House, which after the 24th of June 1725. shall be erected or built within the preceding Boundaries or Limits, any Door-Case, Window, Lintel, Brest-Summer, or Story-Posts or Plates whatsoever, unless where two or more Houses are joined or laid together, and so used as one single House; and that to be no longer than during

the Time of such Usage, upon Pain or Penalty, that the Owner of every such House, for every such Offence, shall forfeit the Sum of 50 l.

And in consideration that Party-Walls built upon old Foundations may decay, and become dangerous, and needful to be rebuilt; and whereas Differences have, and may again arise between the two Landlords, concerning the Expences of taking down the same, shoring up the Floors, and rebuilding them again; it is therefore by the aforesaid Act enacted, That from and after the 24th Day of June, 1725. all and every Person and Persons, inhabiting in any Place or Places, in and about the Cities of London and Westminster, or any other Place or Places compriz'd within the Weekly Bills of Mortality, or within the Parishes of St. Mary le Bone and Paddington, or within the Parishes of Chelsea and St. Pancras, who shall build, or cause to be built, any House or Houses, upon any Foundation, old or new, and who shall find it absolutely necessary to take down any decay'd Party-Wall between such House and the next adjoining House, shall give Notice thereof in Writing to the Owner or Occupier of such adjoining House, full three Months before such Party-Wall shall be begun to be pulled down, to the Intent that the same may be viewed by four able Workmen, within the Space of one Month next after the Service of such Notice; which four Workmen are to be equally appointed by both Parties, that is, each

each Person to appoint two of them, or more, if required, when they both do agree thereto.

But in case that the Landlord or Occupier of the next adjoining *House*, will not agree to the rebuilding of such Party-Wall, or Walls, or is incapable of paying the immediate Moiety thereto, and shall neglect to nominate and appoint, within three Weeks next after the Service of Notice, as aforesaid, such Workmen, that then the other of the said Parties shall nominate or appoint four or more able Workmen, who shall view the Party-Wall required to be taken down and rebuilt; which Workmen, or the major Part of them, shall certify in Writing under their Hands to the Justices of the Peace, in the next General or Quarter Sessions of the Peace, holden for the City or County where such Party-Wall is situated and being, and that such Party-Wall is ruinous, and needful to be rebuilt, &c.

And provided that any Person or Persons whomsoever, shall think him, her, or themselves injured by such Certificate, the said Justices shall summon before them one or more of the said Workmen, or other Person or Persons whom they shall think fit, and shall examine the Matter upon Oath; and their Determination shall be final and conclusive to all Parties, without any Appeal from the same.

But it is to be observed, that a Copy of the Workman's Certificate must be delivered to the Occupier or Owner of such next adjoining *House*, or left there, within three Days after such Cer-

tificate shall be made to the Justices, as aforesaid; and if there shall be no Appeal from the same within three Months after, in every such Case, if such Landlord or Occupier shall refuse or neglect to shore up and support his, her, or their *Houses*, within six Days after the Expiration of the said three Months Notice, that then the first Builder or Builders, with his or their Workmen, (giving Notice as aforesaid,) may lawfully enter into such *House* or *Houses* (at all reasonable Times,) with Workmen and Materials, and therewith shore up and support the same; the Expence whereof shall be paid by the Landlord or Occupier; as also the half Expence of the Party-Wall built by the first Builder, after the Rate of 5*l.* per Rod, for every Rod of Work contained therein.

And when the first Builder shall have built the said Party-Wall, he shall leave at such next *House* with the Landlord or Occupier a true Measurment of the Quantity of Brick-Work contained therein, within ten Days after such Party-Wall shall be so built and compleated; of which one half Moiety, at the Rate aforesaid, as also the Expence of shoring and supporting, shall be paid by the Landlord or Landlords thereof, or their Tenants or Occupiers, who are hereby empowered to pay and deduct the same out of the next Rent that shall become due.

And provided, That Neglect or Refusal of the Money so due be made, and remain unpaid for the Space of twenty-one Days after Demand thereof; then it shall

shall and may be lawful to and for such first Builder or Builders, his, her, or their Executors and Administrators, to sue such Landlord or Landlords for such Sums so proportionably due, by Action of Debt, or on the Case, Bill, Plaint, or Information, in any Court of Record at *Westminster*, &c.

And here note, That the Law here delivered relating to the rebuilding of decay'd Party-Walls, of either Brick or Stone, the same is to be understood and observed of old *Houses*, where instead of having one Party-Wall between them, as this Act directs, have two Timber Walls or Partitions, one belonging to each *House*, and separate from one another; therefore be it understood on all Sides, That whosoever, for the Safety of his or their *Houses*, will pull down his own Wooden Walls or Partitions, and instead thereof build a Party-Wall of Brick or Stone, he or they are also empowered to pull down the next Wooden Wall or Partition of the next adjoining *House* or *Houses*, (if the Landlord will not agree thereto,) and proceed in every Step, as before delivered for the rebuilding of decay'd Party-Walls of Brick or Stone.

Which new-built Wall must be placed equally on both Premises, that is to say, half the Thickness of the Foundation on one Landlord's Land, and the other half on the other; and that all Settings-off in the Foundation be equally the same on both Sides, as directed in the Beginning thereof.

The several Rates of *Houses*, or *Buildings*, appointed after the Fire in 1666. were four.

First, Those of *Allies*, *By-Lanes*, &c. were termed *Buildings* of the first Rate, and were ordained to consist but of two Stories, exclusive of the Cellars and Garrets; whose respective Heights were settled as follows, *viz.* the Height of the Cellar is six Feet and a half, the Height of the first and second Stories each nine Feet, and the Height of the Garrets at Pleasure.

The Scantlings appointed for the Timber of these Buildings, are as follows:

Summers or Girders, whose Lengths are not to exceed 15 Feet, must consist of 12 Inches in Breadth, and 8 Inches in Depth or Thickness; and Wall-Plates 7 Inches by 5 Inches.

Principal Rafters, under 15 Feet, to be 8 Inches by 6 Inches at their Feet, and 5 Inches by 6 Inches at their Top. Single Rafters to be 4 Inches by 3 Inches; and Joists, whose Lengths are more than 10 Feet, must be 7 Inches deep, and 3 Inches in Breadth; excepting those for the Garret Floors, which must be 3 Inches by 6 Inches.

And here observe, Stat. 22. Car. II. That no Joists or Rafters be laid at greater Distance from one another, than 12 Inches, and no Quarters at greater than 14 Inches.

Secondly, *Houses* of the second Rate are such as front Streets and Lanes of Note, consisting of three Stories in Height, exclusive

clusive of the Cellars and Garrets.

The Height of the Cellars must be 6 Feet and a half, (if Springs will allow it;) the Height of the first and second Stories

10 Feet each, the Height of the third Story 9 Feet, and the Height of the Garrets at Pleasure.

The Scantlings appointed for the Timber of these Buildings, are as follows:

First, for the Floors.

Summers or Girders in Length, from $\left\{ \begin{array}{l} 10 \\ 15 \\ 18 \\ 21 \\ 24 \end{array} \right\}$ to $\left\{ \begin{array}{l} 15 \\ 18 \\ 21 \\ 24 \\ 26 \end{array} \right\}$ Feet, must have in their Depths $\left\{ \begin{array}{l} 11 \\ 13 \\ 14 \\ 16 \\ 17 \end{array} \right\}$ Inches and Breadth $\left\{ \begin{array}{l} 8 \\ 9 \\ 10 \\ 12 \\ 14 \end{array} \right\}$ Inches.

Joists which bear 10 Feet, must have in Thickness 3 Inches, and in Depth $\left\{ \begin{array}{l} 6 \\ 7 \\ 7 \\ 8 \\ 8 \end{array} \right\}$ Inches, where the Depth of the Girder is $\left\{ \begin{array}{l} 8 \\ 9 \\ 10 \\ 12 \\ 14 \end{array} \right\}$ Inches.

Binding Joists, with their Trimming Joists, 5 Inches in Breadth, their Depth equal to their own Floors.

Wall-Plates, or Rafting-Pieces and Beams $\left\{ \begin{array}{l} 10 \\ 8 \\ 7 \end{array} \right\}$ Inches, and $\left\{ \begin{array}{l} 6 \\ 6 \\ 5 \end{array} \right\}$ Inches

Lintels of Oak in the $\left\{ \begin{array}{l} \text{first, second,} \\ \text{and third} \end{array} \right\}$ Story, $\left\{ \begin{array}{l} 8 \\ 5 \end{array} \right\}$ and $\left\{ \begin{array}{l} 6 \\ 4 \end{array} \right\}$ Inches.

Secondly, for the Roof.

Principal Rafters, whose Lengths are from $\left\{ \begin{array}{l} 15 \\ 18 \\ 21 \\ 24 \end{array} \right\}$ to $\left\{ \begin{array}{l} 18 \\ 21 \\ 24 \\ 26 \end{array} \right\}$ Feet, must be at $\left\{ \begin{array}{l} \text{Foot 9} \\ \text{Top 7} \end{array} \right\}$ Inches, $\left\{ \begin{array}{l} 7 \\ \text{and} \end{array} \right\}$ 7 Inches thick.
 $\left\{ \begin{array}{l} \text{Foot 10} \\ \text{Top 8} \end{array} \right\}$ Inches, $\left\{ \begin{array}{l} 8 \\ \text{and} \end{array} \right\}$ 8 Inches.
 $\left\{ \begin{array}{l} \text{Foot 12} \\ \text{Top 9} \end{array} \right\}$ Inches, $\left\{ \begin{array}{l} 8\frac{1}{2} \\ \text{and} \end{array} \right\}$ 8½ Inches.
 $\left\{ \begin{array}{l} \text{Foot 13} \\ \text{Top 9} \end{array} \right\}$ Inches, $\left\{ \begin{array}{l} 9 \\ \text{and} \end{array} \right\}$ 9 Inches.

Purlins,

Purlins, whose Lengths are from $\left. \begin{matrix} 15 \\ 18 \end{matrix} \right\}$ to $\left. \begin{matrix} 18 \\ 21 \end{matrix} \right\}$ Feet, must have $\left. \begin{matrix} 9 \\ 12 \end{matrix} \right\}$ Inc. by $\left. \begin{matrix} 8 \\ 9 \end{matrix} \right\}$ Inc.

Single Rafter, whose Lengths do not exceed $\left. \begin{matrix} 9 \\ 6 \end{matrix} \right\}$ Feet, must have $\left. \begin{matrix} 5 \\ 4 \end{matrix} \right\}$ Inches by $\left. \begin{matrix} 4 \\ 3\frac{1}{2} \end{matrix} \right\}$ Inch.

Thirdly, Buildings of the third Rate, are such as front the most principal Streets of Trade, as *Cheapside, Fleet-Street, the Strand, &c.* consisting of four Stories in Height, exclusive of the Cellars and Garrets.

The Height of the Cellars are as in the last preceding, the Height of the first Story 10 Feet, the second 10 Feet and a half, the third 9 Feet, the fourth 8 Feet and a half, and the Garrets at Pleasure.

The Scantlings of Timber appointed for this third Rate of *Houses*, are the same of those of the second.

The fourth Rate of *Houses* being such as are appointed for

Persons of extraordinary Quality, situate in magnificent Squares, &c. may have the Height of their Stories and Scantlings of their Timber at Pleasure; but they must not exceed four Stories in Height, exclusive of the Cellars and Garrets.

And here it is to be noted, That the Height of the first Floor over the Cellars, in *Houses* of the second and third Rates, shall not be more than 18 Inches above the Pavement of the Street, nor less than 6 Inches, with a circular Step without the Building.

Scantlings of Stone appointed for the first, second, and third Rates of Buildings.

First Rate.

	Inches.	Inches.
Corner Piers	18	by $\left. \begin{matrix} 18 \\ 12 \\ 18 \\ 18 \end{matrix} \right\}$
Middle or Single Piers	14	
Double Piers between <i>House</i> and <i>House</i>	14	
Door Jaumbs and Heads	12	

Second and Third Rates.

	Feet.	Inches.
Corner Piers	2	} by {
Middle or Single Piers	1	
Double Piers between <i>House</i> and <i>House</i>	2	
Door Jaumbs and Heads	14 Inches by 10.	

As to Materials; And first of Quartering.

			Feet.				
Single	{	Quarters, whose	{ 8 }	must	{ 3½ }	and in	{ 1¼ }
Double		Lengths are	{ 8 }	have	{ 4 }	Breadth	{ 3½ }
							Inches in Thickness

Secondly, of Laths.

Laths, whose { 5 } Feet, must have one { ¼ } of an Inch in
Lengths are { 4 } Inch in Breadth, and { ½ } Thickness.

As to the Front and Rear Walls.

By the Stat. 19 of Car. II. *Houses* of the first Rate shall have their Cellar Walls in Front and Rear of two Bricks in Thickness, the first and second Stories of one Brick and a half, and the Garrets of one Brick only.

Houses of the second Rate shall have their Cellar Walls in Front and Rear two Bricks and a half in Thickness, the first and second Stories two Bricks, the third Story one Brick and a half, and the Garrets one Brick only.

Houses of the third Rate shall have their Cellar Walls in Front and Rear three Bricks thick, in the first Story two Bricks and a half, in the second, third, and fourth Stories one Brick and a half, and in the Garrets one Brick only.

Houses of the fourth Rate, being chiefly for Noblemen, &c. have their Thickness left to the Discretion of the Architect.

By Stat. 7 of Queen Anne, no Modilion or Cornice of Wood or Timber should here-

after be made, or suffered to be made, or suffered to be fixed under the Eaves of any *House*, or against any Front or Rear Wall thereof; but the Front and Rear Walls of every *House* and *Houses*, shall be built intirely of Brick or Stone, (the Windows and Doors excepted,) to be carried two Feet and a half high above the Garret Floor, and coped or covered with Stone or Brick.

Also by Stat. 7. of Queen Anne, it is enacted, That all Jaumbs and Backs of Chimneys, which shall or may be built, shall consist of one Brick in Thickness at the least, from the Cellars to the Roof; that all the Insides of such Chimneys shall be four Inches and a half in Breadth; that all Funnels shall be plaistered or pargetted within, from the Bottom to the Top; that all Chimneys be turned or arched with a Trimmer under the Hearths with Brick, the Ground Floor excepted; and that no Timber shall be nearer than five Inches

H O

to any Chimney, Funnel, or Fire-Place ; that all Mantles between the Jaumbs be arched with Brick or Stone ; and no Wood or Wainscot shall be placed or affixed to the Front of any Jaumb or Mantle-Tree of any Chimney, nearer than five Inches from the Inside thereof.

That all Stoves, Boilers, Cop-pers, and Ovens, shall not be nearer than nine Inches, at the least, to the adjoining *House* ; and no Timber or Wood to be

H O

nearer than five Inches to any Fire-Place or Flue.

But by Stat. 22 *Car. II. it is enacted*, That no Timber be laid within twelve Inches of the Foreside of Chimney Jaumbs ; and that all Joists on the Back of every Chimney be laid with a Trimmer of six Inches Distance therefrom ; and that no Timber be laid within the Funnel of any Chimney, on Penalty to the Workman for every Default 10s. and 10s. more every Week it remains unreformed.

A TABLE

H O

H O

A TABLE for one Brick in Thickness, or the
Half of Two Bricks.

The Height of the Walls in Feet.

Foot long.	Half Brick.	I Brick.	II Bricks.	III Bricks.	IV Bricks.	V Bricks.
1	5	11	22	33	44	55
2	11	22	44	66	88	110
3	16	33	66	99	132	165
4	22	44	88	132	176	220
5	27	55	110	165	220	275
6	33	66	132	199	264	331
7	39	77	154	231	309	386
8	44	88	176	264	353	441
9	50	99	198	298	397	496
10	55	110	220	331	441	551
11	61	121	244	364	485	606
12	66	132	264	397	529	661
13	72	143	286	431	573	716
14	77	154	309	462	617	771
15	83	165	331	496	661	826
16	88	176	355	529	705	882
17	94	187	375	562	749	937
18	99	198	397	595	793	992
19	105	209	419	628	837	1047
20	110	220	441	661	882	1102
21	116	231	463	694	926	1157
22	121	242	485	726	970	1212
23	127	253	507	760	1014	1267
24	132	264	529	793	1058	1322
25	138	275	551	826	1102	1377
26	143	286	573	860	1146	1432
27	154	309	617	926	1234	1543
28	165	331	661	992	1322	1653
29	220	441	881	1322	1763	2204
30	275	551	1102	1652	2204	2755

H O

H O

A TABLE for one Brick in Thickness, or the
Half of two Bricks.

The Height of the Walls in Feet.

Foot long.	VI Bricks.	VII Bricks.	VIII Bricks.	IX Bricks.	X Bricks.
1	60	77	85	99	110
2	132	154	176	198	220
3	198	231	264	298	331
4	264	309	353	397	441
5	331	386	441	496	551
6	397	463	529	595	661
7	463	540	617	694	771
8	529	617	705	793	882
9	595	694	793	893	992
10	661	771	882	992	1102
11	727	848	970	1091	1212
12	793	926	1058	1190	1322
13	859	1003	1146	1289	1433
14	926	1080	1234	1388	1543
15	992	1157	1322	1488	1653
16	1058	1234	1410	1587	1763
17	1124	1311	1499	1686	1873
18	1190	1388	1587	1787	1983
19	1256	1466	1675	1884	2094
20	1322	1543	1763	1983	2204
21	1388	1620	1851	2083	2314
22	1455	1697	1939	2182	2424
23	1520	1774	2028	2281	2534
24	1587	1851	2116	2380	2645
25	1653	1928	2204	2479	2755
26	1719	2006	2292	2578	2865
27	1787	2160	2468	2777	3085
28	1983	2314	2645	2975	3306
29	2645	3085	3526	3967	4408
30	3306	3857	4408	4959	5510

A TABLE

H O

H O

A TABLE for three Quarters of a Brick thick, being the Half of a Brick and a half.

The Height of the Walls in Feet.

Foot long.	Half a Brick.	I Brick.	II Bricks.	III Bricks.	IV Bricks.	V Bricks.
1	4	8	17	25	32	41
2	8	17	33	50	66	83
3	12	25	50	74	99	124
4	17	33	66	99	132	165
5	21	41	83	124	165	207
6	25	50	99	149	198	248
7	29	58	116	174	231	289
8	33	66	132	198	264	331
9	37	74	149	223	298	372
10	41	83	165	238	331	413
11	45	91	182	273	364	455
12	50	99	198	298	397	496
13	54	107	215	322	430	537
14	58	116	231	347	463	578
15	62	124	248	372	496	620
16	66	132	264	397	529	661
17	70	140	281	421	562	702
18	74	149	298	446	595	744
19	79	157	314	471	628	785
20	83	165	331	496	661	826
21	87	174	347	521	694	868
22	91	182	369	545	727	909
23	95	190	380	570	760	950
24	99	198	397	595	793	992
25	103	206	413	620	826	1033
26	107	215	430	645	860	1074
27	116	231	463	694	926	1157
28	124	248	496	744	992	1240
29	165	331	661	992	1322	1653
30	207	413	826	1240	1653	2066

H O

H O

A TABLE for three Quarters of a Brick thick, being the Half of a Brick and halt.

The Height of the Walls in Feet.

Foot long.	VI Bricks.	VII Bricks.	VIII Bricks.	IX Bricks.	X Bricks.
1	50	58	66	74	83
2	99	116	132	149	165
3	149	174	198	223	248
4	198	231	264	298	331
5	248	289	331	372	413
6	298	347	397	446	496
7	347	405	463	521	579
8	394	463	529	595	661
9	446	521	595	660	744
10	496	579	661	744	826
11	545	636	727	818	900
12	595	691	793	893	992
13	645	752	860	976	1074
14	694	810	926	1041	1157
15	743	868	992	1117	1240
16	793	926	1058	1189	1322
17	843	983	1124	1264	1405
18	893	1041	1190	1339	1488
19	942	1099	1256	1413	1570
20	992	1157	1322	1488	1653
21	1041	1215	1388	1562	1736
22	1091	1273	1455	1636	1818
23	1140	1331	1521	1711	1901
24	1190	1388	1587	1785	1983
25	1240	1446	1652	1860	2066
26	1290	1504	1709	1934	2149
27	1338	1620	1851	2083	2314
28	1488	1736	1983	2231	2479
29	1983	2324	2625	2975	3306
30	2479	2893	3306	3719	4132

HOUSING'

HOUSING, with Bricklayers, a Term which they use when a Tile or Brick is warp'd, or cast crooked or hollow in burning, then they say, *such a Tile or Brick is housing*. Tiles are apt to be *housing* or *hollow* on the Struck-Side (*i. e.* that which was uppermost in the Mould,) and Bricks on the contrary Side.

Some have made this Observation, That Tiles are always smoothest when burnt on the Struck-Side, by reason the Sand sticks to the Under-side, which they strow on the Stock of the Mould, to prevent the Earth sticking to it.

HYDRAULICKS, so called of ὕδωρ Water, and αὐλός, *Gr.* a Pipe or Flute; because at the first Invention of Organs, being unacquainted with the Method of applying Bellows to blow them, they made use of a Cataract or Fall of Water, to make a Wind, and sound them.

The Organs, says *Vitruvius*, were played by the Help of two Suckets, which were pull'd up or let down in the Body of the Pump; which Suckets press'd the Air with Violence into a Funnel revers'd in a Copper Coffer, half full of Water, and press'd the Water, and constrained it so to ascend round about within the Coffer; which operated so, that its Weight, in making it re-enter into the Funnel, push'd the Air into the Pipes, and made them play, producing the same Effects which the Bellows did.

Hydraulicks is that Part of the Science of *Statics*, which con-

siders the Motion of Fluids, and particularly Water, with the Application thereof in artificial Water-Works.

To *Hydraulicks* belong not only the conducting and raising of Water, with the constructing of Engines for those Purposes, but also the Laws of the Motion of Fluid Bodies.

Hydraulicks, therefore, comprehends the Art of conducting Water into Pipes, Canals, Drains, &c. Also the raising it, with the several Engines employ'd for that Purpose; as *Siphons*, *Pumps*, *Syringes*, *Fountains*, *Jets d'Eau's*, *Fire-Engines*, *Mills*, &c.

HYDROSTATICKS, [of ὕδωρ Water, and στατικός, *Gr.* *Statics*] a Science that explains the *Equilibrium* of Fluids, or the Gravitation of Fluids at rest: Upon the Removal of that *Equilibrium*, Motion ensues; and here *Hydraulicks* commence.

Hydraulicks therefore suppose *Hydrostaticks*; and the Generality of Writers, from the immediate Relation between these two, join them together, and call them both either *Hydraulicks*, or *Hydrostaticks*.

But Mr. *Harris*, in his *Lexicon Technicum*, blames Mr. *Ozanam* for mixing and confounding *Hydrostaticks* and *Hydraulicks* the one with the other; since by the first is explained the natural *Equilibrium* or Motion of Water and other Fluids; and by the latter, the Force of mechanical Engines for the forcing it up to great Heights.

H Y

HYPÆTHRON } in antient
 HYPÆTHROS } Architec-
 ture, a kind of Temple open at
 the Top.

Vitruvius says it is an open Building or Portico, such as some antient Temples were, which had no Roof or Covering, as the Temple of *Jupiter Olympius*, built by *Collassius*, a Roman Architect at *Athens*.

HYPERBOLA, in Geometry, is one of the two Lines formed by the Section of a Cone.

The *Hyperbola* arises when the Plane that cuts the Cone is not parallel to one of the Sides, as it

H Y

is on the *Parabola*; but diverges from it outwards, not inwards.

HYPERBOLIFORM Figures, are such Curves as approach in their Properties to the Nature of the *Hyperbola*, called also *Hyperboloids*.

HYPERTHYRON, in the antient Architecture, is a sort of Table used after the Manner of a Frieze over the Jaumbs of *Dorick* Doors and Gates, and the Lentils of Windows. It lies immediately under the Corona; and our Workmen usually call it the *King-Piece*.

The END of the First Volume.

The following are ADDITIONS and CORRECTIONS communicated to the Compiler of this Work after the Sheets were printed off; therefore not being willing to omit any Thing that may be of Service to the Publick, but to make this Work as Compleat as possible, we have inserted them here by Way of

S U P P L E M E N T.

A S

IN the Article ASHLERING, instead of 4 *d.* to 6 *d.* read from 18 *d.* to 2 *s.* per Square.

In BALUSTER, for 3 *d.* per Yard, read 3 *s.* per Yard; tho' the Prices are various, according to the Goodness of Workmanship.

In the Article BARNS. have no Dependance on the Prices set down.

In the Article BATTEN Doors, as to their Price, have no Dependance; for no Price can

be set on them, without knowing the Dimensions.

BATTER is a Term used by Workmen, to signify that a Wall, Piece of Timber, or the like, doth not stand upright, but leans into the Building; if it leans from the Building, they say it *over-hangs*.

BAULKS } Are small young
BALKS } Fir-Trees, the slender Tops being cut off, and hew'd up, brought from *Norway*.

Load

Load BAULKS are large Pieces of Fir-Timber, which are brought from *Norway*, from one Load to four or five in one Piece.

In the Article BEAM FILING, add 3*d.* or 4*d.* per Foot has been given for Workmanship, where it has been troublesome, as in a Country Church, or where they have been obliged to scaffold, or use long Ladders.

BOND, a Term among Workmen, chiefly Bricklayers, who say, *Make good Bond*; by which they mean so to dispose the Bricks or Stones, that the Joints may not be immediately over others.

First, a Bricklayer lays a Stretcher, or Brick long-ways in the Building, beginning at the Corner, and so on all Stretchers in that Course; then upon that he lays next a Header, beginning at the same Corner; next to that a Closer, which is Part of a Brick, about two Inches; which, with the Header already laid, is about six Inches and a half with the Mortar between them, then there is left about two Inches and a half for *Bond*, as they call it, which will cause the Middle of the next Header to lie over the Joint of the two Stretchers of the under Course; and so they lay Headers all along in the same Wall, which they call *Flemish Bond*.

Or first they lay a Header, then a Closer, next a Stretcher, then a Header, next a Stretcher, and so on to the End of the Wall; then on the next Course a

Stretcher to begin with, which will span over the under Header and Closer, and cover about two Inches of the under Stretcher; then next a Header, and so on to the End of the Wall, which they call *English Bond*.

To the Article BOULDER-WALLS add, Some Workmen lay Laths in the Wall angle-ways, and then cross them somewhat like a Net, every two or three Feet in Height, which prevents it falling down in moist and rainy Weather.

In the Article BRICK-WORK, instead of *thinner*, read *thicker*.

Also to that Paragraph, the *Base of the Gable*, in the same Article, add, or the Base of the Gable being 24 Feet, take three Fourths of that, which is the Length of the Rafter, which is 18 Feet; three Fourths of that, which is 13 Feet 6 Inches, is the Perpendicular nearly.

So few Writers having said any Thing of Timber-Bridges, a late Author having presented us with the following Plan of one, I have here inserted it. This he explains as follows:

Let A* be the Plan of the Bridge, supposed to extend any Length, not exceeding one hundred Feet, nor twenty-four Feet in Breadth; let B* be the Side or Upright of the same; and let C* be the Section of the same by a larger Scale.

The better to conceive the Particulars, he directs to observe in A*, that *aaaa* are the Butment or Support to each Shore; and let *bb* be the tying Beams, which

are

B R

are halved into the Posts; also let *cc* be the bearing Beams; and let *dddd* be the binding Joists, which are let into the bearing Beams, as in the Plate C* D* at T; also let *eeee* be the Plan of the several King-Posts.

And in B observe, that *ff* is the Top of the Water at its common Level, and let *gg* be the Butments or Support to each Shore; also let *hh* be the tying Beams, as halved into the Posts; let *ii* be the Plate for the Braces *ll* to rest on, which support the Posts *kk*; so do the Braces *mm* discharge the whole Weight; and let *nn* be Struts to help the Strength, as by butting against each Brace; let *ooo* be the top Place or Rail, and *pp* a Plank weathered to throw the Water off.

N.B. The additional Beams *℥ ℥* do add prodigiously to its Strength.

And in C*, which is the Section by a larger Scale, let *qq* be the Posts, and *rr* the bearing Beam, framed therein, and let *ss* be the binding Joists: Also let *tt* be the top Rail, being wider than the rest, to preserve the Joints the better; and let *uu* be the Plank weathered to throw the Water off; yet better, as at *ww*.

It is necessary to let the tying Beam into the Posts a small Matter, because the Plank *xx* bears on it, as well as on the binding Joists; let *yy* be Straps of Iron bolted through the Posts, in or-

C A

der to strengthen the same; the lower Bolt goes through the said Strap, and comes under the bearing Beam, and which, with the Joggle *zz*, preserves a good Bearing for the Beam, which ought to be truss'd, as shewn in the Plate B; and *℥ ℥* is the Gravel and Paving.

To preserve the Timber the better, let the Truss B* be boarded on each Side.

In the Article CANT, for *turn it about*, read *turn it over*.

In the Article CEILING, as to the Price, add, This is to be understood of the Journeyman's Price from the Master; and also the Price, with Materials, is for common Camp Work; for Work which is done very well is worth twice that Sum.

To the Article CHIMNEYS add this, which is a more easy and natural Method.

Let the Stack of Chimneys to be measured, be as in the Plate.

First, prepare the Measuring-Book, by ruling it into ten Columns; the first for Remarks, the second for so many Times over as you are to measure Things of the same Dimensions. As for Example: If you have two Hearths in a Stack of Chimneys of the same Dimension, and on one Floor, you need set but one down in your Book, and say twice over, that is, put down 2 in the second Column, and put down double the Product under that Word, fifth Column; if the first Dimension was to be done twice over, you set down 2 in the

C H

the second Column over-against 6 F. 6 I. and make the Product 9 Feet 8 Inches.

The third Column is for the Dimensions; the fourth for so many Bricks as the Wall is thick; the fifth for the Product of the Dimensions, when multiplied together; the sixth for the Products of the Deductions; the seventh for reducing the Products into $1\frac{1}{2}$ Brick thick, as the eighth is for one Brick; and the other two for reducing the Deductions to their Thickness.

If you are to reduce the first Dimensions, whose Product is 4 10, and 5 Bricks thick, multiply it by 5, which is 24 2 in one Brick. The next Dimension is 6 6 by 1 1, whose Product is 7 Feet (not regarding the odd 6 Parts) and 4 Bricks thick; put 7 twice down in the seventh Column, which is a Three-Brick Wall, and 1 down in the eighth Column for one Brick more, which is the four Bricks Thickness.

If you are to reduce the Product of 13 1, which is a Deduction, and $2\frac{1}{2}$ Bricks thick, put first 13 1 in the ninth Column, and 13 1 in the tenth.

If you are to reduce the Pro-

C H

duct of 9 2, F. $1\frac{1}{3}$ Brick thick, put 9 2 in the eighth Column, and $\frac{1}{3}$ of 9 2 under it in the same Column, for that will be 12 2 in one Brick in Thickness, and something more; but those odd Parts are seldom regarded in Practice, it gives the Turn of the Scale to the Master, and amounts to a very small Matter at the End.

When all this is done, you add up the four last Columns; the first, or seventh Column is 331 3 reduced to $1\frac{1}{2}$ Brick; the next 216 4 of 1 Brick thick, then you deduct the third or ninth Column of $1\frac{1}{2}$ Brick from 331 3, there remains 312 8; then deduct the last Column 61 8 from the eighth, 216 4, there remains 154 8; which multiply by 2, and divide by 3, which brings 103 the Thickness of $1\frac{1}{2}$ Brick, which add to 312 8, is in all 415 8, the Standard Thickness of a Brick and half Wall; which divide by 272 (the $\frac{1}{4}$ being not regarded in this Work) there will be 1 Rod 143 Feet, which divide by 68, will bring it to Quarters and 7 Feet remaining; which is in all 1 Rod $\frac{1}{2}$ and 7 Feet, as will appear by the Table.

Remarks.

Remarks.	Times over.	Dimensions.	Bricks thick.	Product.	Product de- dusted.	Reduced to $1\frac{1}{2}$ Brick.	Reduced to one Brick.	Deductions re- duced to $1\frac{1}{2}$ Brick.	Deductions re- duced to one Brick.
Fronting of Chimney		F. I. 6 6 9 5		F. I. 4 10			F. I. 24 2		
Foundation above fetting off		6 6 1 1	4	7 0		7 7	7		
Deduct		3 6 1 7	$2\frac{1}{2}$		5 6			5 6	5 6
First Story		9 7 5 10	4	55 11		55 11 55 11	55 11		
Deduct Chimney		3 6 3 9	$2\frac{1}{2}$		13 1			13 1	13 1
Second Story		8 7 5 6	4	47 2		47 2 47 2	47 2		
Deduct Chimney		3 9 3 0	$2\frac{1}{4}$		11 3				11 3 11 3 2 9
Part of lower Funnel		8 7 1 10	1	15 9			15 9		
Third Story		7 6 4 3	$3\frac{1}{2}$	31 10		31 10 31 10	15 11		
Deduct Chimney		3 3 2 9	2		8 11				8 11 8 11
Part of lower Funnel		5 0 1 10	$1\frac{1}{2}$	9 2		9 2			
Part of the other		5 0 1 10	$1\frac{1}{3}$	9 2			9 2 3 0		
Shaft		9 0 4 3	$2\frac{1}{2}$	38 3		38 3	38 3		
272) 415 (1 Rods.						331 3	216 4	18 7	61 8
68) $\frac{143}{136}$ (2 Quarters.						18 7	61 8		
<u>7 Feet.</u>						312 8	154 8		
<u>Standard Feet</u>						103	2		
In all $1\frac{1}{2}$ Rod and 7 Feet, $\frac{2}{8}$ 15 $5\frac{1}{2}$						415 8	308		
at 5 l. 15 s. per Rod,							1 4		
To bring this into Money, look on the other Side.						3)	309 4	(103	

C H

C H

At five Pounds fifteen Shillings *per* Rod, what is the Amount of one Rod and a half and seven Feet? First,

One Rod is	_____	_____	_____	l. 5	15	00
Half a Rod is	_____	_____	_____	2	17	06
Seven Feet is as below	_____	_____	_____	0	02	11½
Whole Amount				8	15	05½

For the 7 Feet bring the Pounds into Shillings, which is 115; which multiply by 12, to bring it into Pence, which is 1380 Pence, the Pence in five Pounds fifteen Shillings: Then say,

If 272 Feet be worth 1380 Pence, what is 7 Feet?

$$\begin{array}{r}
 7 \\
 \hline
 272 \overline{) 9660} \text{ (35 Pence.} \\
 \underline{816} \\
 1500 \\
 \underline{1360} \\
 \text{Divided by } 68 \overline{) 140} \text{ (2 Farthings.} \\
 \underline{136} \\
 4 \\
 \hline
 \end{array}$$

Which is the Quarter of 272, which will bring it into Farthings; as to what remains, is but $\frac{4}{68}$ of a Farthing, and not worth regarding.

Chimney's Proportion, according to some Moderns.

Chimneys in	Breadth.	Height.	Depth.
Kitchen	6, 8, or 10	4½, 5, or 6	2½ or 3
Halls	4, 5, or 6	4, or 4½	2, or 2-3
Chambers	3-6 to 4	3-9 to 4	22 Inches.
Studies and Wardrobes	2-6 to 3	3-6 to 3-9	18 Inches.

To

To the Article CLINKERS add, a sort of small yellow Bricks which are brought from Holland.

To the *Method of drawing a COLUMN*, add this engraven *Column* following, which is by far more preferable.

In the Article CONTENT, for *forty-three* read *forty*.

In the Article COPING, instead of *4 d. a Foot*, read *that it will cost in London 2 s. a Foot running Measure*.

In the Article CORNICE, in the Paragraph beginning thus, Mr. *Wing* says, &c. add, Mr. *Wing's* Free-Stone *Cornice* is very cheap: He should have told us where it was done for that Money, for it will not suit *London*.

The Price of Free Stone or Bath Stone *Cornice* about *London*, of about 18 or 20 Inches thick, is worth about 10 or 11 s. per Foot running Measure of *Portland Sone*, 15 or 16 ditto.

Wooden *Cornice* is worth about 10 d. per Foot superficial Measure.

DENTILS. *Vitruvius* is said to prescribe the Breadth of each *Dentil* or Tooth to be its Height, and the Indenture or Interval between each two, he directs to be two Thirds of the Breadth.

As *Dentils* are much in use among the modern Workmen, so are they fit to be recommended as a very pretty and beautiful Ornament, if perform'd well.

Left the young Workman should fall into any Mistake, by what is said above from so great an Author as *Vitruvius*, I shall

make the following Observation, and give you the Words of Mr. *Evelyn*, in his Account of *Architects* and *Architecture*, page 35 and 36.

I do not remember any of the Architects who have wrote since *Vitruvius*, that gives these Dimensions to *Dentils*. They may appear in large and massive Buildings very grand, according to *Vitruvius*; but the Proportions which are given them by other Masters suit best with our modern Buildings: And what *Vitruvius* means by Modillions, representing Purlins, *Dentils*, and the Ends of Rafters, I know not, for I never understood *Dentils* to represent or signify any Thing more, than a Row or Gang of Teeth.

Dentils (saith Mr. *Evelyn*) are the Teeth (a Member of the *Cornice*) immediately above the Cymatium of the Frieze, by some named also *Asseri*, from their square Form; I say, in the *Corinthian* and *Ionian*, &c. for in the *Doric* Order they were not antiently admitted, or rather properly, according to the Opinion of our Master, (viz. *Vitruvius*.) though we must needs acknowledge to have found them in the most authentical Pieces extant. As for their Dimensions, they kept to no certain Rule, but made them sometimes thicker, sometimes thinner, square or long, and more in Number; commonly the Spaces less by an half, sometimes by a third Part, than the Teeth, which were themselves twice as high as their Breadth, and frequently (especially

cially in more polite Orders,) beginning with the Cone of a Pine pendent at the very Point over the angular Column. *Lomatius* is yet more precise in this Particular, and gives them as much Height as the middle Fascia of the Architrave Projecture, equal (somewhat too much,) Front, twice the Breadth of their Height, and a third Part less than their Breadth, for Vacuity. The *Dentils* have sometimes a small Regula, and now and then more than one, as usually in the *Ionica*, where it has likewise an *Ovolo* or *Echinus* for the Bedding of the Corona; but if enrich'd, and that two of them encounter, one should be simple and plain, as where it happens to be insert'd beneath it. Next to this superior *Echinus* are the *Modillions*; but instead of them *Dentils* are thought to have been first instituted, and for that Reason superfluously join'd where *Mutules* are; and therefore, where we find *Tænia* under *Modillions*, it is not properly divided into Teeth; nor is it rashly to be imitated, though we have some great Examples to countenance it. That of the *Pantheon* may safely guide us herein, where it is left plain for this very Cause, and that the Reason of the Thing does not in Truth allow it. However, it must be acknowledged, nothing has been more grossly abused, even amongst our most renowned Masters.

In the Article *DIAL*, and in the Paragraph, The best Wood for this Purpose is the *clearest*

Oak, and the reddest Fir, if it be not turpentiney, read the clearest Wainscot; and yellow Fir, clear of dead Turpentine Knots.

In the Article *DOORS*, and Paragraph beginning thus, In small Buildings, &c. add, the Moderns seldom exceed three Feet for the Front *Doors* of small Buildings, and the Chambers from two Feet four to two Feet ten, and two Diameters and one Third in Height.

In the Article *FACIA*, and to the Paragraph beginning thus, The Price of Fascia's is, &c. add, the Price of Brick Fascia's, with Materials, is one Shilling two Pence per Foot superficial Measure, Moulding on the same is one Shilling and ten Pence per Foot superficial Measure.

In the Article *FEATHER-EDG'D*, instead of *Side* read *Edge*.

To the Article *FENCING*, add, these Prices of *Fencing* here mentioned, may be what poor labouring Men may have in the *Weald* of *Sussex*, but are not fit for the rest of the Kingdom.

Paling with three Rails and Pales, is worth in some Parts of *Kent* fifteen or sixteen Shillings per Rod, if done well, finding all Materials. And *Paling* with two Rails and Pales, is worth thirteen or fourteen Shillings per Rod; Posts and Rails cross a Field is worth four Shillings per Rod, finding all Materials.

In the Article *FLOORS*, and in Paragraph The Price, &c. after *eleven Shillings*, add the Word *Workmanship*.

To the Article FLOOR-ING, to the Paragraph beginning thus, Mr. *Leybourn* says, &c. add,

The Price of Boarding *Floors* in and about *London*, is as follows:

Boarding with whole yellow Deals, with folding Joints, from twenty-two to twenty-four Shillings *per Square*.

Ditto, Sap-sifted, that is, the Sap cut all out, two Pounds *per Square*.

Common straight Joint Boarding, thirty-five Shillings *per Square*.

Second best *ditto*, forty-six Shillings *per Square*

Dowell'd, fifty-six Shillings *per Square*.

Chan *Floors*, i. e. Boards without Knots, and dowell'd, from five to seven or eight Pounds *per Square*.

In the Article FRAMING add, Mr. *Leybourn* certainly means that he fells, hews, and finds the Timber into that Price. Instead of twelve Shillings *per Ton*, it should be forty Shillings *per Ton*; add that to the rest, and it will be about a *Sussex* Price for Oak,

If you would estimate the Value of a Square of *Framing* for a Barn after the *Sussex* Method, for some Place near *London*, it is thus:

	<i>l.</i>	<i>s.</i>	<i>d.</i>
To twenty-five Feet of <i>Mardo</i> Fir Timber, at thirty Shillings <i>per Load</i>	0	15	0
To sawing <i>ditto</i>	0	03	0
To <i>Framing</i>	0	05	0
To Weather-Boards, sixteen at nine Pence <i>per Piece</i> , and Coin Boards	0	13	0
To Work and Nails	0	05	0
	2	01	0

This is above three Times the *Sussex* Price; but it is easy to see where he failed in his Estimate: He has undervalued the Timber much, as to Price; has accounted for sawing the Boards, but says nothing about the Timber they are to be

VOL. I.

sawed out of; the Sawing too little by one Third, for he supposeth rough Timber: In short, it is all Blunders.

But if the Workman would make a true Estimate of a Barn, the Scantlings must be all ascertained and fixed, the Dimensions

F R

sions of the Barn given, as the Length, Width, and Height, if the Planks be Oak, and the rest Fir.

First, cube the Plates, that is, measure how many solid Feet there is in the said Plates; then cube the Fir, that is, find the solid Content in Feet in the whole Carcase in the large and small Timbers; then find how many Squares of Weather-Boarding, and Squares of Thatching, with what Locks, Hinges, &c. is wanted, according to your Agreement; then make a fair Bill of it all, as if it were already done, as under: This will take up some Time, (for I would advise the Workman to draw it all up on Paper, with the several Scantlings, which will make it very easy to compute, and he will avoid Mistakes,) but it will answer his End, for he will be sure of his Gain before-hand, and not work by Guess, as is the Way among most Workmen

F R

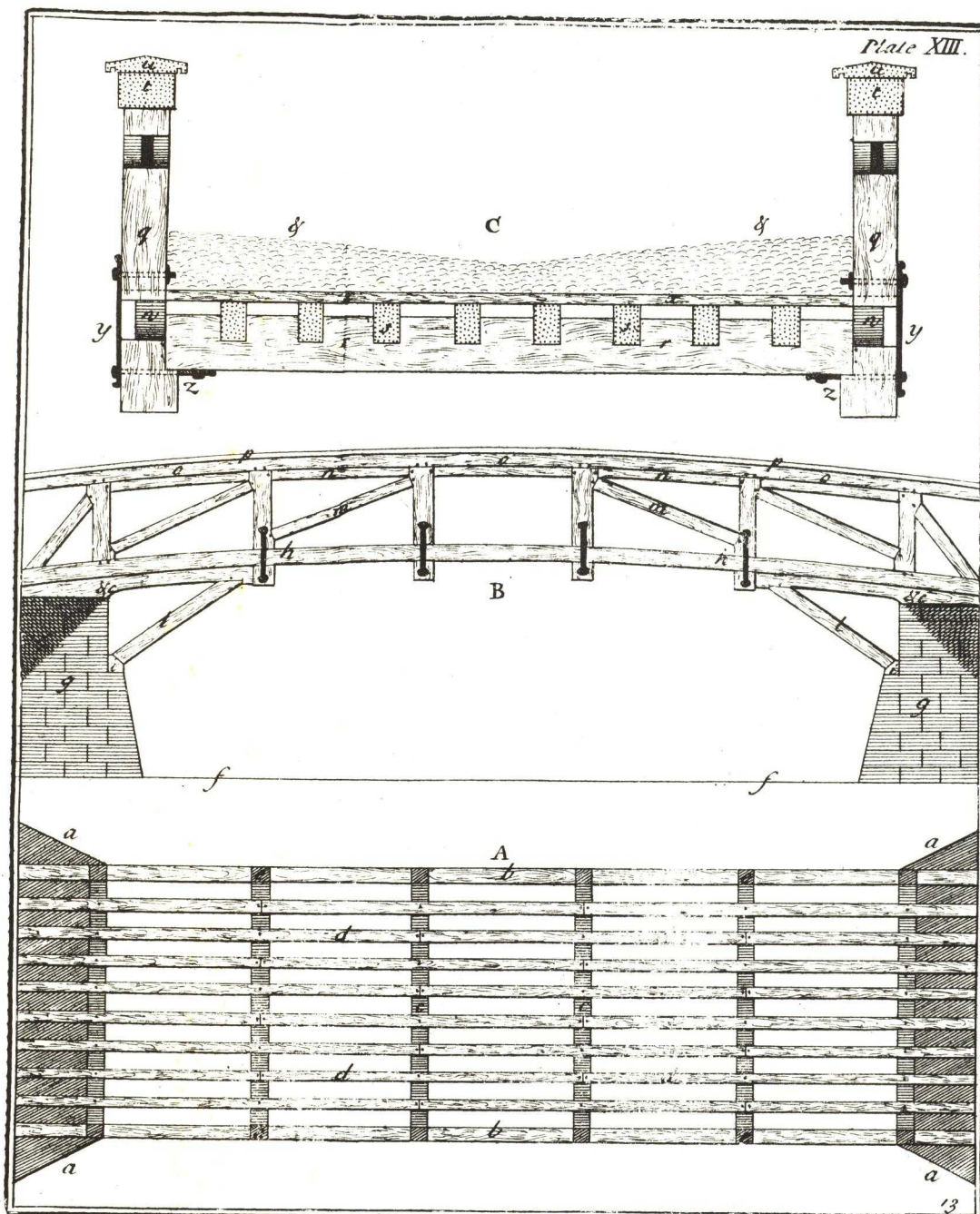
that are not acquainted with Figures. And here I cannot but condemn the Method used by the ordinary Workmen in *London*, of measuring the Area or Ground Plat of the Building only, and making their Estimate from thence, as erroneous.

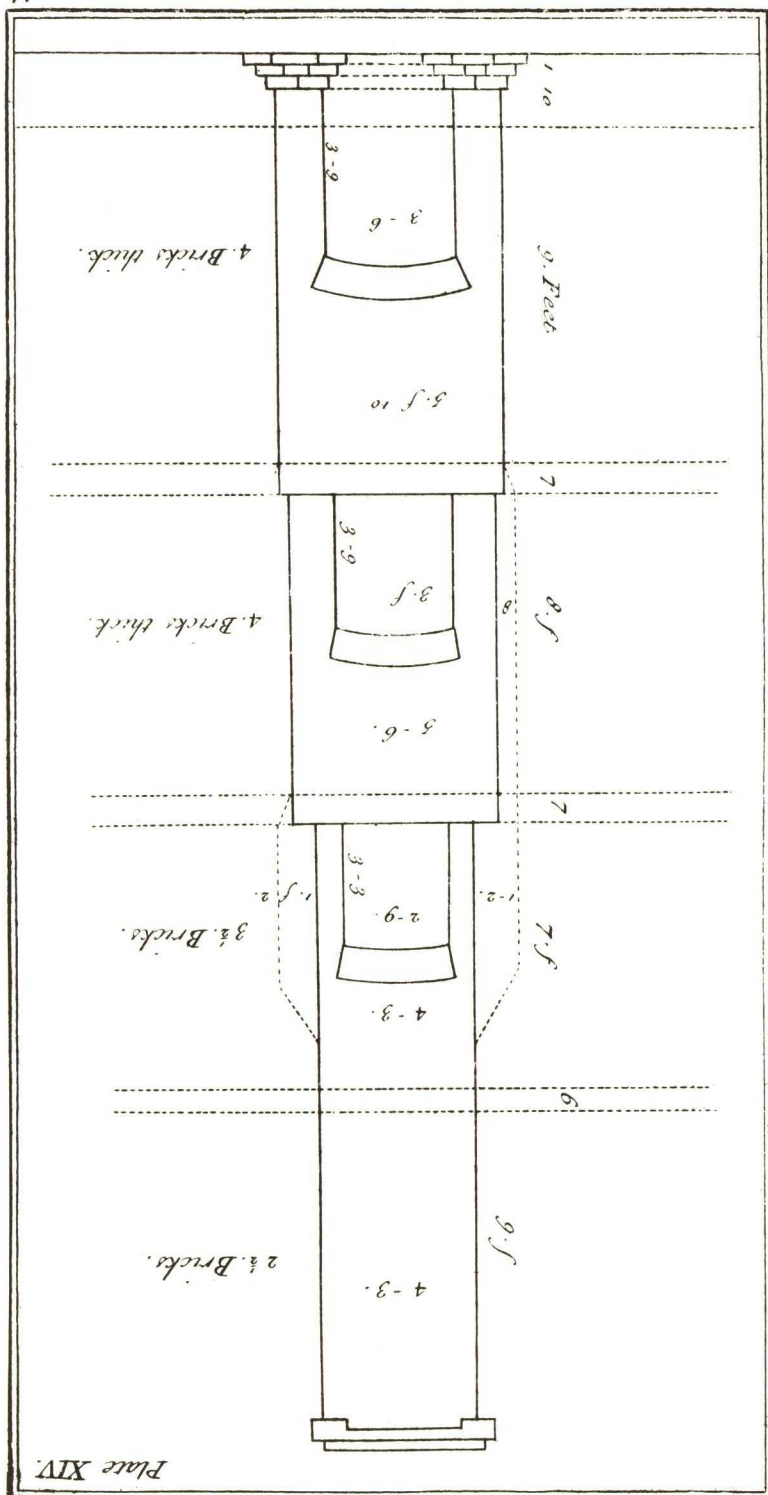
For let the Plan be ten Feet square, as for Instance, a Summer-House, the Walls of that Building will be forty Feet about, and the Area one Square; then admit another Building of twenty Feet square, which is four square on the Plane or Area, the Wall of this Building will be 80 Feet about; so the building of one Square hath Walls half the Quantity of that of four square: But this is but one Error among a great many that accrue in this Method of estimating; and I would advise the young Workman to have no Regard to this lazy and idle Method, lest he pay too dear for it in the End.

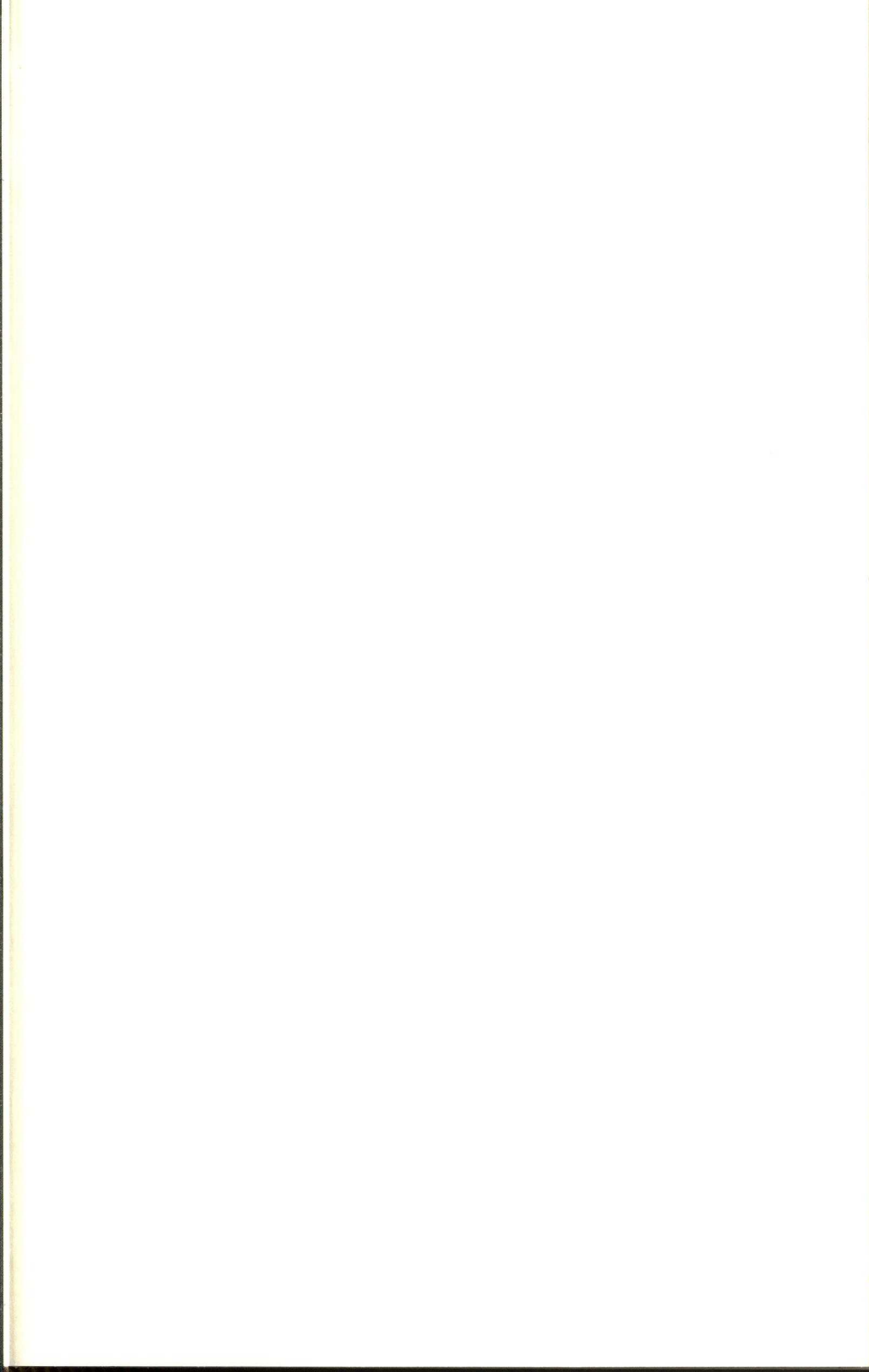
The Manner of the Bill for an Estimate.

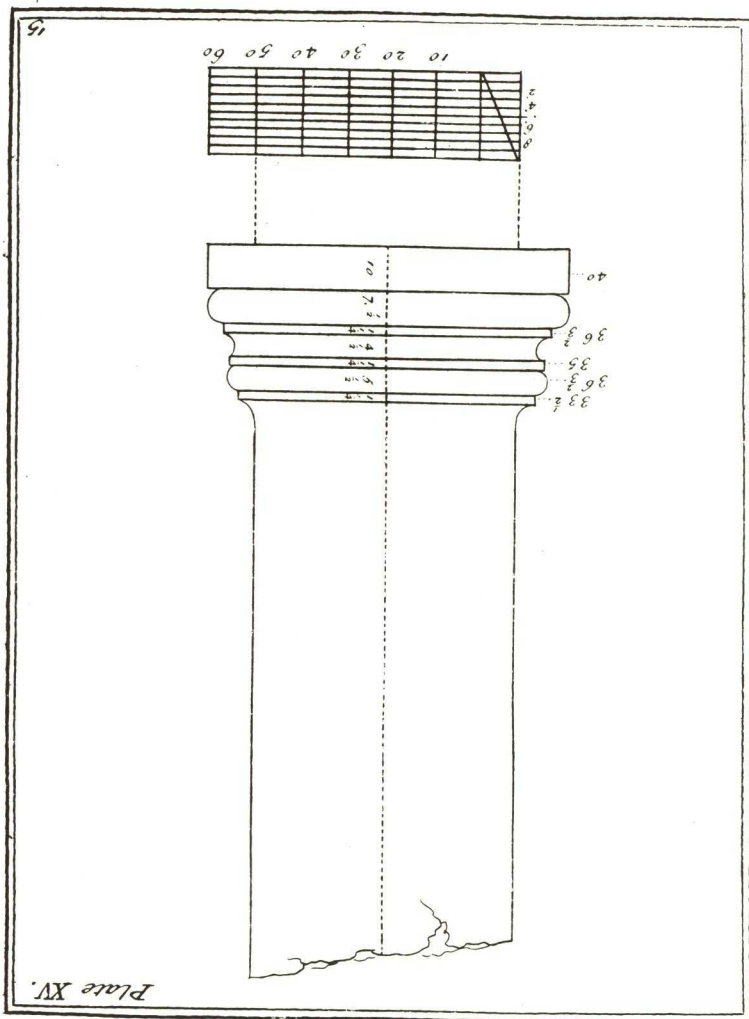
	<i>l.</i>	<i>s.</i>	<i>d.</i>
To sawed cub'd Oak in Plates, 40 Feet at 3 <i>s.</i>	06	00	0
To sawed cub'd Fir in Carcase, 571 Feet at 20 <i>d.</i>	47	11	8
To 28 Squares 75 Ft. broad Weather-boarding, at 18 <i>s.</i>	25	17	6
To 18 Squares Pantiling, at 18 <i>s.</i>	16	04	0
To 160 Feet Underpinning, at 6 <i>d. per Foot</i>	04	00	0
To Hinges, Locks and Staples, &c.	00	14	0
	100	07	0

The above Prices are the *London* Prices for Work and Stuff.











FRONT. To this Article add, There is no certain Price for this Work by the Rod, but it is always done by the Foot, the Price more or less, according to the Goodness and Variety of the Workmanship.

GUTTERS. To this Article add, *Gutters* should never have less than a quarter of an Inch to a Foot for Drip, and the Soldering cros the *Gutter* is, always to be avoided, and the Length of the Lead, from Fall

to Fall, should never exceed 14 Feet.

In the Article **HOUSE**, to the Paragraph beginning thus, Some Workmen pitch the Ends of Timber, &c. add, The best Way to preserve the Ends of Timber in the Walls, is to let them have Air, and nothing to touch them.

In the Article about **LATHS**, instead of four Inches in Breadth must have half an Inch in Thickness, read, a quarter of an Inch.

N. B. We hope the Reader will make all proper Allowances in Prices, when better Work or Materials shall exceed the Scheme of these Computations.

In the Press,

AN INTRODUCTION to the *MATHEMATICKS*:

Being MATHEMATICAL LECTURES read in the publick Schools at the University of *Cambridge*. By ISAAC BARROW D. D. Professor of the *Mathematicks*, and Master of *Trinity College*. To which is prefix'd, The ORATORICAL PREFACE of our Learned Author, spoke before the University on his being elected LUCASIAN Professor of the *Mathematicks*. Translated by JOHN KIRKBY A. M.

Likewise in the Press,

GEOMETRICAL LECTURES,

Read before the University of *Cambridge*. By ISAAC BARROW D. D. Translated by EDMUND STONE F. R. S.

N. B. These Two Volumes of the Learned Dr. BARROW's LECTURES were never before translated, and will be published in February next.

Printed for STEPHEN AUSTEN, at the *Angel and Bible* in *St. Paul's Church-Yard*.

BOOKS Printed for A. Bettesworth and C. Hitch,
in Pater-noster-Row; and S. Austen, in St. Paul's
Church-Yard.

A Book of Psalmody, containing Chanting Tunes for *Venite Exultemus, Te Deum Laudamus, Benedicite, Jubilate Deo, Magnificat, Nunc Dimittis*, and the Reading Psalms; with 18 Anthems, and Variety of Psalm Tunes. In Four Parts. The Seventh Edition, Corrected and Enlarged by JAMES GREEN. Price stich'd 2 s. being the completest Book extant.

CAMPANOLOGIA: Or, The Art of Ringing. Improved and Completed. The Second Edition. Price 1 s. 6 d.

A NEW ENGLISH DISPENSATORY. In Four Parts. Contain-
ing, I. A more accurate Account of the Simple Medicines, than
any hitherto extant. II. The Official Compositions, accord-
ing to the last Alterations of the College at London: To which
are added, The Emendations of the *Edinburgh Dispensatory*; and
many other Compositions, taken from the Practice of our Hospi-
tals, and the most Celebrated Authors. III. Extemporaneous
Prescriptions, taken from the best Authors, and the most Eminent
Physicians now in Practice. IV. A Rational Account of the
Operation of Medicines, To which are added, The Quantities
of the middle Syllables of the *Latin* Names, express'd by long
and short Marks. So that this DISPENSATORY answers at the
same Time the Purpose of a *Prosodia Pharmaceutica*. By JAMES
ALLEYNE, M. D. Price 6 s.

The ANTIQUITIES of LONDON and WESTMINSTER; being an
Account of whatsoever is Antient, Curious, or Remarkable, as to
Palaces, Towers, Castles, Walls, Gates, Bridges, Monasteries,
Priories, Sanctuaries, Nunneries, Religious Houses, Cathedrals,
Churches, Chapels, Colleges, Inns of Court, Hospitals, Schools,
and other Magnificent Buildings; as Exchanges, Halls, Crosses,
Markets, Goals, and all publick Edifices; also Rivers, Brooks,
Bourns, Springs, &c. and many other Curious Matters in Anti-
quity; whereby will plainly appear the Difference between the
Antient and Present State of those two famous Cities.

The Second Edition. Price 2 s.

